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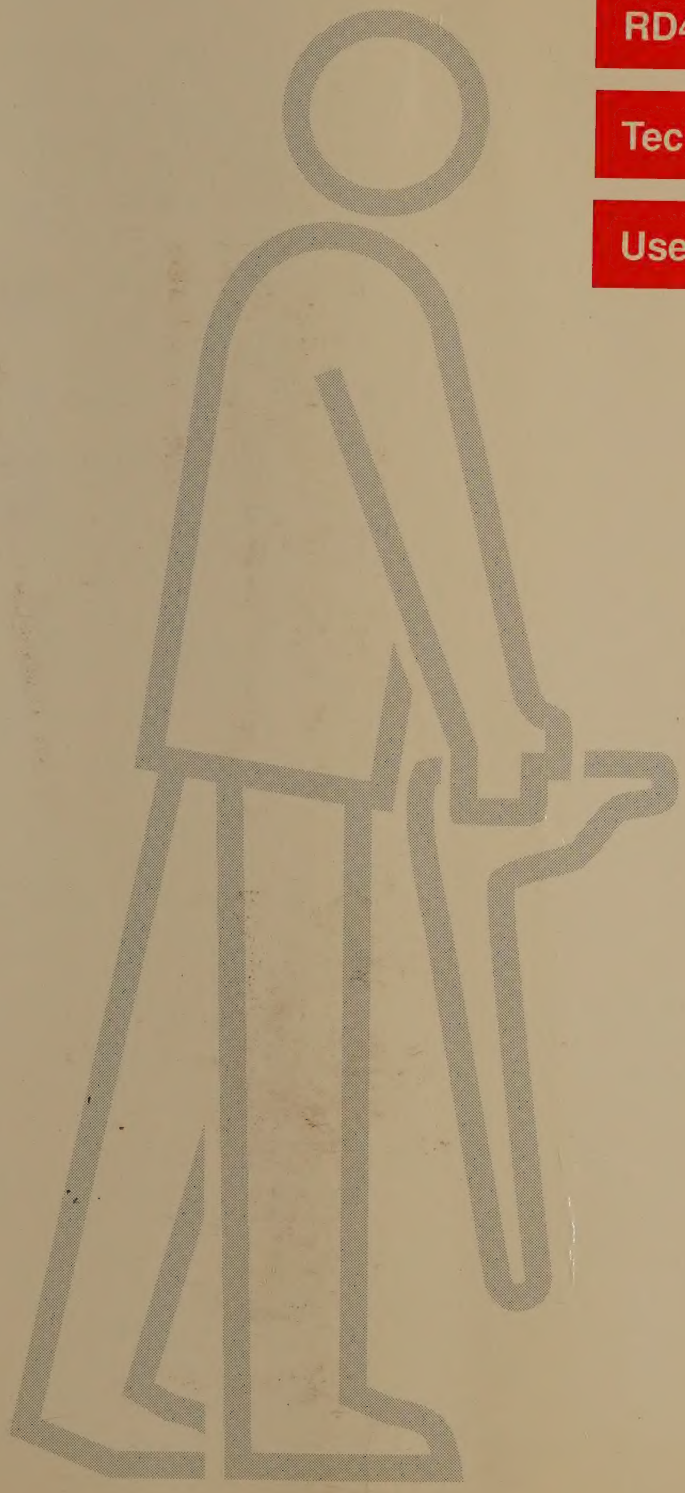
Radiodetection®

RD432PDL precision locator

Technical data

User information



NOTICE

This book is a comprehensive reference for the user of an RD400 series locator. Keep it in a safe place.

Refer to Section A 'Locator features' and to Sections 3.1 thru 3.4 *before using the locator.*

A RD432PDL precision locator

Technical information
Features
Specification

B Optional accessories for an RD432PDL precision locator

C Transmitting sondes for tracing drains, ducts and other applications

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Radiodetection make every effort to ensure that information about locating equipment and its use is correct but do not accept responsibility for damage or problems caused through use of the equipment: priority must always be given to following national and local safety requirements. We are continually developing our products and the design of Radiodetection equipment is subject to change without notice.

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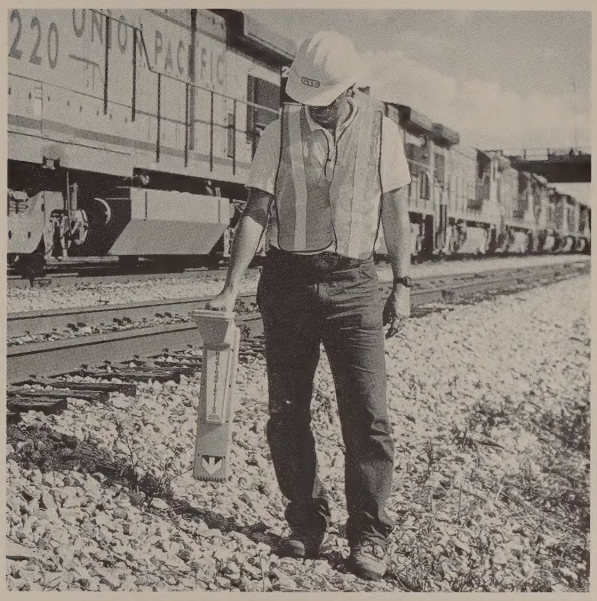
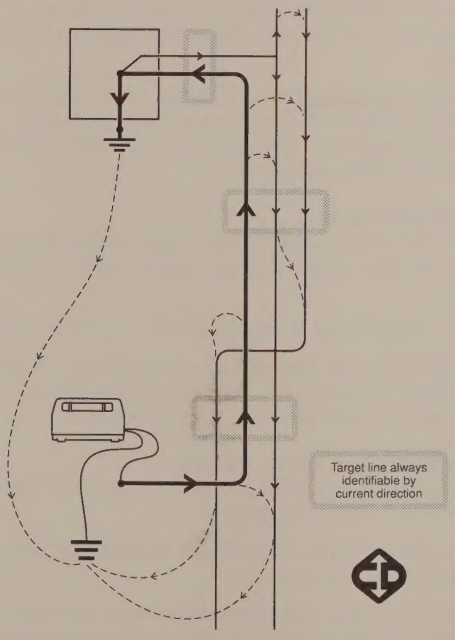
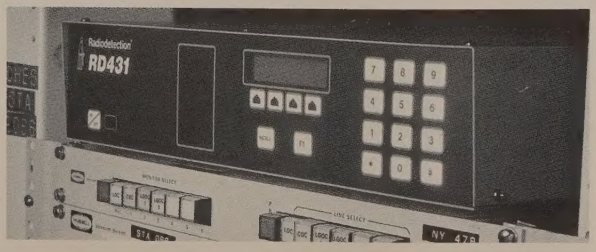
Section A

RD432PDL Precision Locator technical information







Precision instrument for locating and identifying buried pipes and cables
The RD432PDL has been specially developed for operators of long line cable systems, long distance pipelines and utility distribution networks.

The locator operates at low frequency for minimum coupling to other nearby lines and to provide maximum tracing distance. A comprehensive series of filter banks prevent ambient 50/60Hz signal from interfering with the performance of the locator.

Whether on a longline or a distribution system the RD432PDL makes precision locates to a target line and it positively confirms line identity in congested and confusing situations. It is the locator for users for whom accuracy and positive identification are critical.

Precision pinpointing
The receiver has two locating aerial arrays. The position of a peak response over the target line with the twin horizontal aerials can be confirmed with the null response of the vertical aerial. The point where the responses correspond is a precision pinpoint and is a suitable position for making an accurate depth measurement to the target line by pressing the Depth key and reading the depth on the digital display.

Positive identification
In addition to being a sensitive receiver for locating buried lines, the receiver includes two functions to verify the identity of a target line in a congested and confused situation. Keying in the CM Current Measurement function measures the actual current on the line in mA. The user can therefore distinguish a deep target line from a shallow line to which the signal may have coupled and which often gives a stronger response.

The CD Current Direction recognition function indicates the onward signal applied with the transmitter to the target line and distinguishes it from any signals finding their return path on adjacent lines. The forward pointing arrow on the display indicates the target line and the backward facing arrow indicates any adjacent lines to which the signal has coupled.

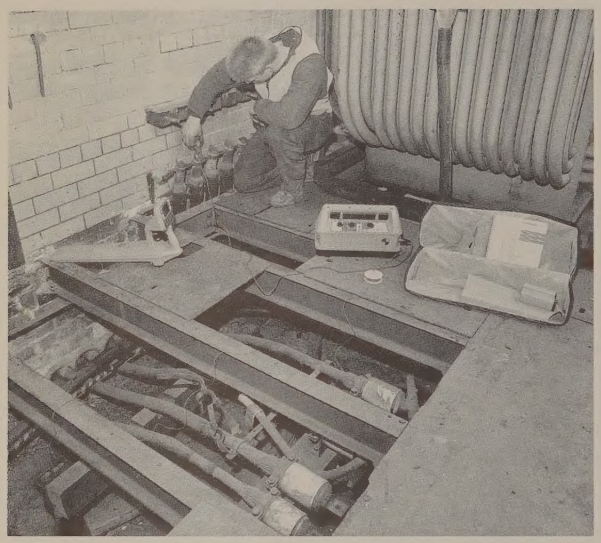
The CM and CD features combine to make line identification very positive even in the most difficult circumstances.

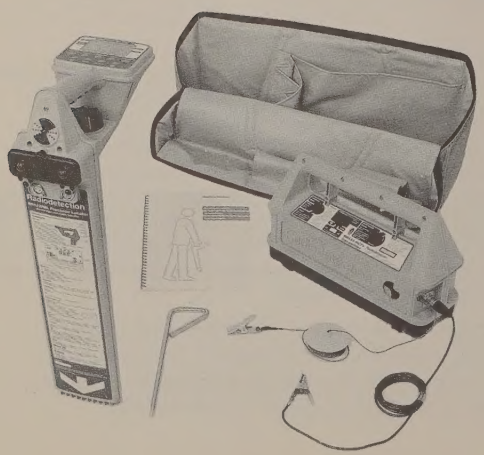
Choice of transmitters
The RD432PDL is available with a choice of transmitters. The RD431 Line Management System transmitter is permanently rack mounted in a telecom regeneration station, pump house or a compressor station. The 30W transmitter can apply its signal over long distances, even up to 150km/100 miles on a telecom longline. The transmitter is microprocessor controlled with alphanumeric display and there is a DTMF (Dual Tone Multi Frequency) interface for remote telephone control and communication through an internal speech synthesiser.

The RD433HCTx portable transmitter is for use on distribution networks. It is lightweight and powered by internal batteries; it can also be powered by a locally available 12V supply such as an auto battery.

A

RD432PDL Precision Locator technical information





In each case the low frequency signal needs to be directly connected to the target line to give maximum tracing distance and locating precision.

Versatility: Other locating modes
In addition to its special ability to locate and positively identify target lines, the RD432PDL can also be used as a general purpose locator. Its 8kHz locate mode is ideal for locating all types of buried metal pipes and cables; the transmitter signal can be clamped, induced or directly connected to a line and it can trace non metallic ducts and drains by locating transmitting sondes as they are propelled along the duct.

In addition, the receiver has a P search mode for locating the 50/60Hz energy on buried power cables and other lines and an R search mode for locating long lines that do not radiate any of their own energy: the R mode is specially useful for detecting telecom trunk lines.

These additional locate modes make the RD432PDL a very versatile instrument.

CM function
The Current Measurement function is available in both the 512Hz and the 8kHz modes. Its main application is for verifying the identity of a target line in a congested area, but it is also useful for defining the main line from a tee at a joint or splice.

The CM function can also be used to make a special survey to evaluate insulation or coating condition of a line. Repeating the survey provides highly relevant information about any coating deterioration.

Display and controls
The receiver has a liquid crystal display that indicates responses, gain, depth, current, battery state, modes and functions.

There is a loudspeaker and a socket for a headphone.

The control keypad provides the user with the choice of modes and functions and Touch Gain gives all the advantages of auto gain with manual override.

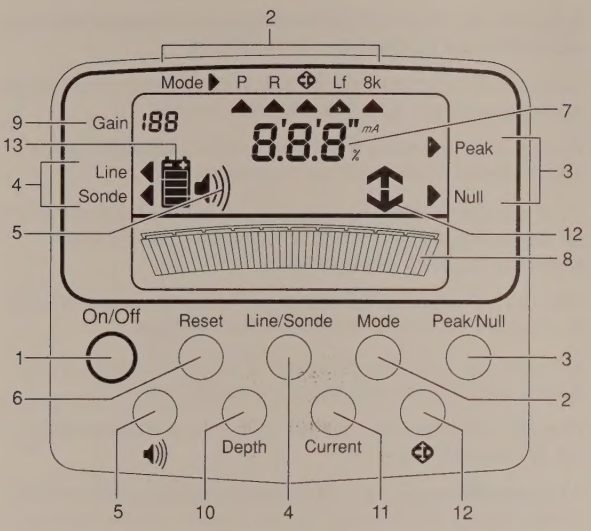
Convenience and a long site life
The RD432PDL has been specially designed for day long use with minimum user fatigue.

The equipment is very rugged and designed for site use in all weathers and climates.

The receiver and portable transmitter nest in a small sized carry bag or case that can be fitted into a crowded van or auto.

Optional accessories
Sections B and C detail a wide range of optional accessories that includes different type antennas, clamps and other devices for applying the transmitting signal as well as a wide range of transmitting sondes.

RD432PDL Precision Locator features



Receiver functions and display

1 Press On/Off key to activate the receiver which remains energised for five minutes. Loudspeaker pulses then waits for 30 seconds before automatically switching off. Pressing any key (apart from On/Off) or adjusting Touch Gain (16) keeps the receiver on for a further five minutes.

Press On/Off key to reactivate receiver once it has switched off.

Press On/Off key whilst receiver is activated to turn it off.

Receiver checks microprocessor and display circuitry at each switch on.

Mode, function choices and gain setting remain unchanged for future use after switch off.

1/6 Test. With the receiver switched Off. Press and hold Reset key then momentarily press On/Off key to initiate check of receiver function, calibration and sensitivity.

Display segments appear momentarily. Display (7) indicates 'rSt' followed by 'PAS' (pass) or 'FAL' (fail).

Error #2 or #3 (9) indicates there is too much interference from external power sources. Move to a quieter site.

2 Press Mode key to select either either P Power or R Radio passive modes or the active mode corresponding to the transmitter frequency. Each key depression moves through the choice of modes indicated at the top of the display.

3 Press Peak/Null key to select either horizontal aerials for a peak response or vertical aerial for a null response. Peak is more accurate than Null and used for all locating.

Use null to verify a peak pinpoint or for speedy tracing (21).

Accessories do not work when the receiver is in null and this is indicated by error #1 in display (9).

4 Press Line/Sonde key to select either line for all locating work except when locating the transmitting sonde for tracing non metallic ducts and drains.

5 Press 🔊 key to increase or decrease response.

6 Press Reset key to cancel ⊕ error indicated on digital display (9) or previously selected ⊕, Depth or Current.

7 Digital display indicates the receiver response to a signal. It also provides information connected to other functions.

8 Meter indicates response to a signal. Adjust Touch gain (16) if meter goes off scale.

9 Indicates receiver gain in dB. Also indicates error code number when 'Err' is indicated on digital display (7).

10 Press Depth key to measure distance to an active signal on a target line. Digital display (7) indicates 'dEP' for a few moments followed by the measurement in either metres/centimetres or feet/inches.

Error #11(9) indicates that receiver is being moved while registering depth.

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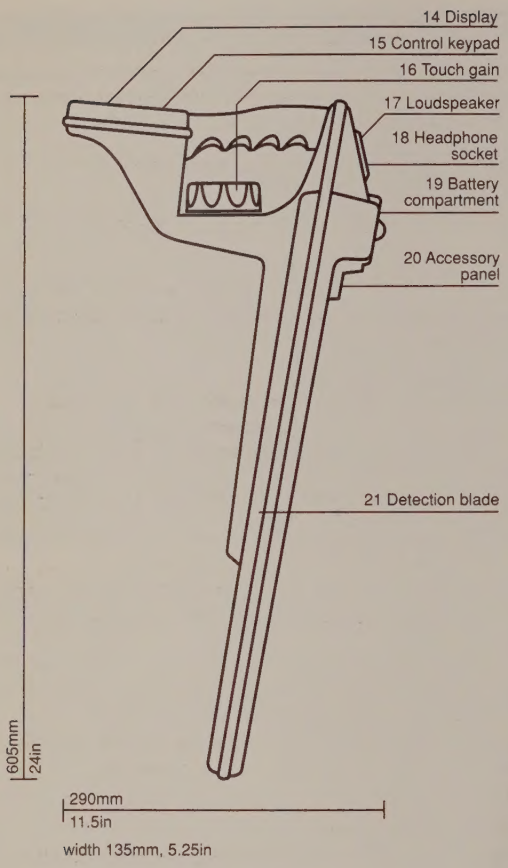
RD432PDL Precision Locator features



Error #21 (9) indicates that the target line is deeper than the 4.5m/15ft max pushbutton measurement.

Error #9 (9) indicates that the signal is too small or too large to measure depth. Check transmitter settings.

Error #12 (9) indicates that there is too much interference from external power sources to measure depth.

11 Press Current key to measure mA value of active signal on target line. Digital display (7) indicates 'cur' for a few moments followed by the reading.

Error #9 (9) indicates that the signal is too small or too large to measure current. Check transmitter settings.

Error #13 (9) indicates that there is too much interference from external power sources to measure current.

Error #20 (9) indicates that the current to be measured is out of receiver range.

12 Press ◁▷ key to indicate Current Direction on target line. Digital display (7) indicates 'cd' for a few moments followed by backward or forward pointing arrow (12). If display (7) indicates 'no cd' go back to last CD locate and reset. To reset Current Direction press and hold down Reset key then momentarily press the ◁▷ key. Release the Reset key. Digital display (7) will indicate 'rSt' and 'sEt' followed by the forward pointing arrow (12).

Error #10 or #80 (9) indicates that the receiver has not reset Current Direction. Check transmitter settings.

Error #22 or #44 (9) indicates that CD signal is too small. Increase transmitter signal strength.

13 Continuous indication of battery. Display pulses and 'LO bAt' appears in display (2) for 30 seconds before automatically switching off, indicating that 12 x AA (LR6) alkaline batteries require replacement.

14 Liquid crystal display indicates responses, modes and functions.

Optional illumination can be fitted to the display for night working.

15 Control keypad for choosing modes and functions.

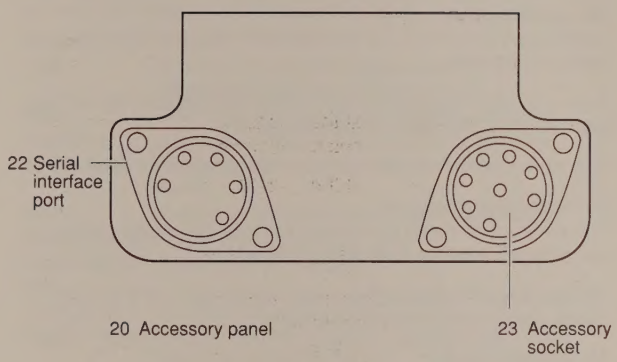
16 Touch gain
A clockwise touch increases gain. Counter clockwise touch decreases gain. If the meter (8) is off scale a touch will automatically adjust gain to a band for convenient locating. If response is already indicated on meter, a touch will trigger a small incremental increase or reduction. Gain (9) on the display indicates relative decibel gain level.

17 Loudspeaker
The speaker is not activated at low signal levels. The speaker tone is complementary to the meter and identifies the signal. The eye sees the response to the signal and the ear identifies it.

The vane can be rotated to reduce tone volume.

18 Headphone socket
The speaker vane can be rotated to give access to the socket. Headphones should have a resistance of <lOOΩ.

RD432PDL Precision Locator features



19 Batteries
Unscrewing the fastener at the top of the cover opens the battery compartment. There are two battery holders each with 6 off AA (LR6) alkaline batteries. Always replace all the batteries when there is a low battery condition.

Check that battery polarity is correct before closing the compartment.

Rechargeable packs are available as an option.

20 Accessory panel
Panel is fitted with two sockets. Socket (a) for fitting accessories. Socket (b) is an RS 232 communications port for fitting a data logger. (Future option).

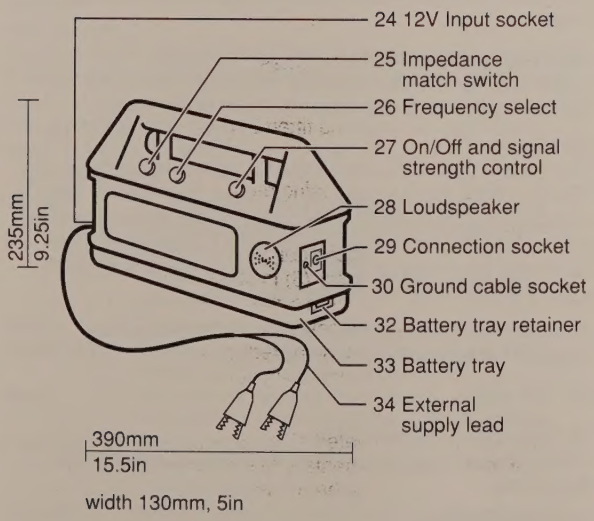
21 Detection blade
The search aerials are fitted inside along the blade. Pressing Peak key (3), the aerials give a peak response with the blade vertical, at right angles to the target line and directly over it. Pressing Null key the receiver gives a null response directly over the line regardless of the receiver orientation.

Peak response gives a more accurate locate and should be used for all locating work. Null should be used to verify a peak pinpoint or for speedy line tracing when accuracy is not important.

22 Serial interface port (Future option).

23 Accessory socket
The accessory socket fitted to the panel is for plugging in optional antennas such as the double depth, clamp or stethoscope.

Optional accessories
Optional receiver accessories are described in Section B.



RD433HCTx high power transmitter

The RD433HCTx high power transmitter transmits a 512Hz or 8kHz signal. It has been designed specifically for longline locating of pipes and cables, and incorporates the ⇔ Current Direction feature.

24 Power socket
The external supply, often from a motor vehicle, is very useful when a high power signal is applied for long periods. The socket comes with a plug and lead which can be wired to any external 12V supply. The supply by-passes the battery pack to energise the transmitter directly.

25 Impedance match switch
This facility enables the transmitter to make the most efficient use of the available power. Always start by using the low setting. If more signal is needed, try the higher setting. Monitor the speaker tone to check that the higher setting gives more signal, i.e. more tone change. If it does not, return to the lower setting.

26 Frequency select switch
Selects either a 512Hz, 8kHz or ⇔ signal. 512Hz is available in connection mode only, not Induction.

27 On/Off and signal strength control
The rotary control combines on/off and power level.

Conserve batteries and always switch to Off when the transmitter is not in use.

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RD432PDL Precision Locator features

The rotary control adjusts signal strength from 2% to 100%. Start locating with the level control set to *Normal.* This will give adequate signal level for most applications. Only use *High* level when more signal is needed - for long distance tracing or deep lines. Sudden increase in speaker tone indicates the transmitter is overloaded. Turn control back until tone drops. Generally, keep the control set as low as possible - this will prolong battery life and avoid unnecessary signal coupling.

28 Loudspeaker
Continuous tone from the loudspeaker indicates that the batteries are live.

A drop in tone indicates when a direct connection signal has been applied successfully to a target line.

The vane can be rotated to mute the loudspeaker tone.

29 Connection socket
The connection cable or options such as the signal clamp are plugged into the connection socket.

Fitting the connection cable or an option such as the signal clamp disables the induction mode.

30 Ground socket
The green ground cable plugs into the green socket to provide a return path for the signal whenever the transmitter is directly connected to a target line.

The ground socket is not used with the signal clamp or in the induction mode.

31 Induction
The induction aerial is partly housed in the transmitter handle. Once the transmitter has been switched on it radiates an induction signal until an accessory is plugged into the connection socket which disables the induction mode.

32 Battery tray retainers
Insert thumbs into each retainer and push down, then pull out to release the battery tray from the transmitter.

33 Battery Tray
The battery tray of the RD433HCTx transmitter is fitted with 10 x D (LR20) battery cells as standard. Low battery state is indicated by interruption in the signal to the receiver and in the loudspeaker tone every 5 seconds. Transmitter shuts down and loudspeaker gives short pulse every 5 seconds when battery becomes inadequate.

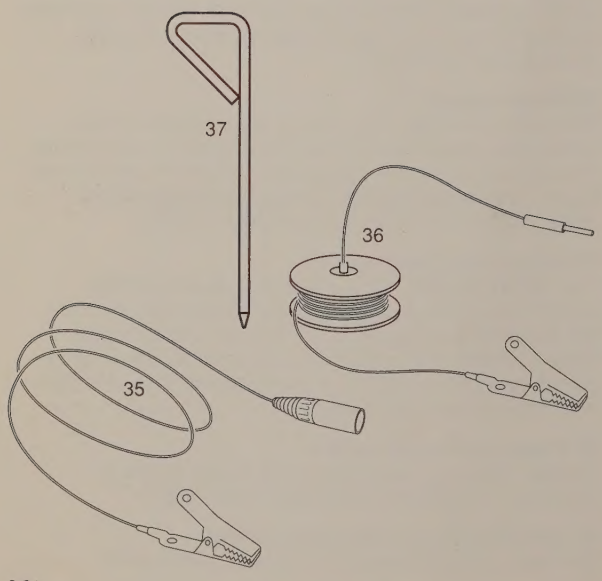
A battery tray fitted with rechargeable D cells can be supplied as an option for the transmitter.

34 12V cable

35 Direct connection cable
Connects the transmitter signal with the clip directly to a target line.

36 Ground cable
10m/yard ground cable on a spool with a clip for attaching to a ground point or stake.

37 Ground stake
Stake for making a ground connection to provide a return path for the signal.



RD432PDL technical specification

Receiver RD432PDL

Detection system
Radiodetection patented twin horizontal aerial system for directionality and interference rejection. Peak response when blade is vertically above conductor and at 90° to it.

Special dual-winding design for symmetrical response.

Vertical coil array for null response and rapid convenient tracing.

Input socket for receiver accessories. Coil systems are disabled automatically when an accessory is connected.

Output

LCD	2 section; simulated analogue meter and digital/numerical data with status flags.
Mode	Status flag shows selected operating frequency.
Peak/Null	Status flag shows which coil option is selected.
Sonde/Line	Status flag shows which depth calculation will be used.
Gain	3 digit number shows relative gain setting in db.
Battery gauge	Shows battery status in 4 steps.
Loudspeaker icon	Shows speaker loudness setting.
Lamp icon	Shows to warn that backlight is on.*
Digital display	3 large numerals to display signal strength, depth and other numerical data.
Arrows	Forward/Backward arrows to indicate current direction.
Analogue section	41 bar scale indicates signal strength to accuracy of ±1.5%.

Loudspeaker
Threshold inhibits speaker sound when signal is less than 20% of meter full scale.
Output sound derived directly from detected signal - alien signals can be audibly identified.
3.5mm mono jack for headphones.
Waterproof speaker. Socket for optional headphones.

Controls

Gain control
3 position switch, spring biased to central position. Gain is increased or decreased by holding the control clockwise or counter-clockwise.

One touch system: When signal strength meter is off-scale showing that gain setting is too high or too low, a single touch of the gain control automatically sets gain to a usable level.

9 key contol panel

On/Off	Push to switch on or off. Auto-off system ensures that instrument is not left on inadvertently. It will not switch-off while being used. Microprocessor and display circuitry checked at each switch on.
Reset	Enables user to 'escape' from a function.
Sonde/Line	Enables correct depth calculation to be selected. Sonde is only available in active modes.
Mode	For selecting required operating frequency. Sequentially cycles through the available options.
Peak/Null	Enables selection of either: - Twin horizontal coil 'Peak' reading. - Vertical coil 'Null' reading.
Speaker	Allows speaker loudness to be changed. 3 levels of loudness or silent can be selected.
Depth	A single press automatically calculates and displays depth. Available in active frequency modes and Peak only.
Current	Available as for depth. Calculates and displays actual line signal strength in mA. Not available in Sonde mode.
⊕	Active only when CD Mode is selected. Calculates and displays current direction on LCD arrows.

Functions

Depth	Accuracy: ±5cm/2" and 5%. Range: to 3m/10'0" (line) to 7.5m/25'0" (sonde)
Backlight*	Switched on by holding Reset and Loudspeaker keys. Automatically reset to off when instrument is switched off.
Current measurement	Accurate to ±10%.
Test	This function is selected by using the On key while holding Reset. Self test mode uses actual magnetic field; checks system for function, calibration and sensitivity.
Illegal functions	When a non-permissible combination is selected, eg. Depth/Null - display shows 3 lines and ignores the request.
Dynamic range	110db (100db in Radio mode).
Batteries	12 x 1.5V alkaline (IEC LR6). 30 hours intermittent use at 20°C. Unit is protected against inadvertent polarity reversal.

Optional rechargeable batteries and chargers (110V or 240V) can be supplied (See section B).

Weights	2.3kg with batteries (5lb).
Environmental	Vibration tested to BS2011. Waterproof to IP54. Operating temperature, -20°C to +50°C.
Modes	Power Radio CD LF (normally 512Hz) 8kHz

Accuracy
Plan location, 5% of depth. (Transmitter signal on a single, straight conductor).

Twin parallel conductors carrying equal signals can be found with accuracy better than 10% of depth when the separation is greater than 1.5 times their depth.

Vertical guide
Omni-directional bubble level enables vertical positioning to within 1/2 degree of arc.

* Optional feature.

Transmitter RD433HCTx

Signal
Continuous sine wave, changes to pulse to warn low battery condition.

Frequency
LF (normally 512Hz), 8192Hz or CD.

Controls
Signal strength: Off, low, normal and high output level switch rotary control. Frequency: Switch for LF (normally 512Hz), 8kHz or CD.

Modes
'Induction' 'connection' automatically selected when cable or accessory is plugged in.

RD432PDL
technical specification

Level switch
Changes output impedance match to optimise signal efficiency.

Loudspeaker
Sounds to warn that the unit is energized. Variable pitch to indicate quality of signal connection. Mechanical 20dB attenuator.

Signal output
Adaptive circuitry montitors output voltage and current and adjusts levels automatically to give maximum output current that is consistent with safety and interference regulations. Speaker tone changes up indicating output is being limited.

Output levels

	Level 1	Level 2
Open circuit voltage	30V	50V
S/C current	140mA	85mA
Optimum load	120Ω	350Ω
Power	2W	2W

Loudspeaker continuity indication
Variable frequency tone. Output current of 0.1mA causes noticeable change.

Induction mode
Apparent power, 8kHz 30 VAR.

Output protection
Output circuitry is protected against inadvertent connection to conductors at up to 250V at 50/60Hz.

Batteries
10 x D (LR20) cells only. AA batteries should not be used in RD433HCTx. Life: 40 hours normal use.

Battery test: Continuously checks battery under actual load conditions.

Battery warning: Pulsed speaker tone and output signal (in any mode) indicates low battery.

Unit is protected against polarity reversal.

Optional rechargeable batteries and chargers (110V or 240V) can be supplied.

External supply
12V socket - min. 10V, max. 18V.
Maximum current drawn - 1A.

Standard equipment
200cm/80" lead with clip for line connection. 10m/20ft lead on spool with clip for ground connection. Ground stake. Carry bag.

Weight
3.5Kg (7.7lb) with D (LR20) cell batteries.

RD432PDL construction

Housings
Housings are manufactured in mid grey from a high impact thermoplastic alloy for good mechanical strength. All access points are sealed against water ingress and control shafts have a double-lip rubber seal. Plastic cone loudspeakers are fitted to maintain weatherproof integrity to IP 54 and NEMA IV.

Circuitry
Integral wiring harness links controls to the main circuit boards via proprietary plugs and sockets. Circuitry can be calibrated without dismantling. All sub-assemblies can be replaced using only a cross head screwdriver and line-nose pliers.

Receiver aerials are PCB mounted so that the PCB can be replaced as a calibrated, tested module.

Temperature range
-20°C+50°C -4°F+122°F.

User information
An illustrated User Information Manual is supplied.

RD432PDL order codes

Complete RD432PDL sets: receiver, transmitter, standard accessories, User Information Manual and carry bag.

RD432PDL with high power Tx	10/RD432PDLHPK*
Receiver display illumination - optional	10/RD4LIGHT

Refer to Section B for information and order codes for optional locator accessories.

Refer to Section C for information and order codes for transmitting sondes to enable the receivers to trace non metallic ducts and drains.

Each part of the RD432PDL kit is available separately:

RD432PDL receiver	10/RD432PDL*
RD433HCTx transmitter	10/RD433HCTx
RD400 carry bag	10/RD400BAG
RD400 rigid carry case	10/RD400CASE

*Add FT to order code if receiver depth calibration is required in feet.
*Add RC to order code if rigid carry case is required in place of carry bag.

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Section B

RD400 series Locator optional accessories

Optional accessories increase the usefulness of RD400 series locators and extend their scope.

Accessories for receivers

*Accessories marked * need the accessory module when used with the RD400SL receiver. Accessory module is fitted as standard on other receivers.*

R1 Summer headphones and winter headphones
Headphones are lightweight or heavyweight for use in different climatic conditions.

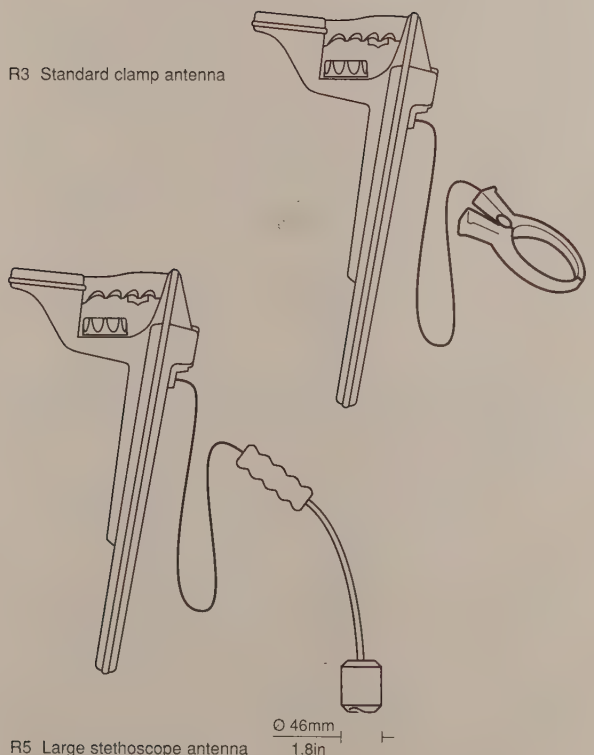
	Order code
Summer headphones	10/RD40119S
Winter headphones	10/RD40119W

R2 Rechargeable nickel cadmium batteries
Direct replacement plug-in units. A set comprises two 6-cell battery packs and a dedicated charger. If the receiver is used frequently, a second pair of battery packs is recommended; one can be used while the other is charging.

Recommended charge time is 14 hours. Batteries must be removed from the receiver for charging.

	Order codes
Pair of 6-cell batteries and 240V AC charger	10/2X6XAA240SET
Pair of 6-cell batteries and 110V AC charger	10/2X6XAA110SET
Spare pair of 6-cell batteries	10/2X6XAANICAD

R3 Standard clamp antenna



R5 Large stethoscope antenna

R3 Standard clamp antenna*
The clamp plugs into the receiver accessory socket and is used for cable identification at access points. The Standard Clamp is suitable for cables up to 10cm/4in diameter.

Order code 10/RD40124

R4 Small clamp antenna*
The Small Antenna Clamp performs the same function as the standard clamp but is useful in cramped situations with insufficient access for the standard clamp. Suitable for cables up to 5cm/2in diameter.

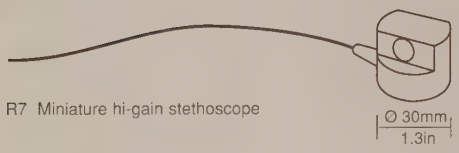
Order code 10/RD40124-2

R5 Large stethoscope antenna*
The Large Stethoscope Antenna plugs into the receiver antenna socket and is used for cable identification in situations where the cable is exposed. It is particularly useful for identifying heavy cables lying in a tray where the clamp cannot be used. The concave detector head on the end of the insulated flexible goose neck is placed firmly against the cable to be identified. If there are a number of cables the stethoscope antenna will give the strongest response from the cable to which the transmitter signal has been applied.

Order code 10/RD40123

RD400 series Locator optional accessories

R6 Small stethoscope



R7 Miniature hi-gain stethoscope

R9 Submersible double depth antenna

T1 Magnetic cable connection clip

T2 Telephone connection cable

R6 Small stethoscope antenna*
Small Stethoscope Antenna has a 25mm/1in concave head at the end of a 2m/78in lead. The small stethoscope can be screwed into an extension rod or used at the end of several extension rods joined together for identifying inaccessible small cables. Instructions as for the large stethoscope.

Order code 10/RD40310

R7 Miniature hi-gain stethoscope*
The Miniature Stethoscope is similar to the Small Stethoscope but has no handle or facility for extension rods.

The Miniature Stethoscope can also be used as a miniature antenna for locations where the bulk of the receiver makes it inconvenient for use. For example, to locate pipes or cables hidden in walls.

Order code 10/RD40878

R8 Double depth antenna*
The Double Depth Antenna is plugged into the receiver accessory socket and its aerials substitute those in the receiver. The double depth antenna gives pushbutton depth measurement down to 6m/20ft. The target is pinpointed with the antenna and the depth button depressed as normal. The depth indicated on the display is doubled to obtain the true depth reading.

Order code 10/RD4SL0246

R9 Submersible double depth antenna*
The Submersible Double Depth Antenna is used in the same manner as the standard double depth Antenna but is suitable for use under water for tracing pipes or cables below a river bed. The antenna is supplied with 10m/33ft (longer length on request) submersible marine cable so that the antenna can be carried by a diver on the river bed and the receiver is used in the vessel. It is important to have effective communication between the receiver and the diver with the antenna.

Alternatively the antenna can be fastened to the end of a non metallic boom from a barge and lowered to the level of the sea bed.

	Order code
Double depth antenna, submersible	96/AC1104-33
Additional cable per metre/yd	10/RD0246SUBCABL

Accessories for transmitters

T1 Magnetic cable connections
The clip is not always large enough to fasten onto valves or other large objects. The option of a strong magnet on the connection and ground cables allows the transmitter signal to be applied through the magnet and onto the target.

The magnet is also useful for sticking to a metal lighting column to apply the signal to the cable.

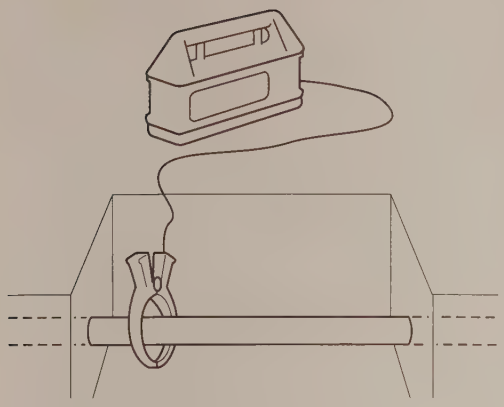
Order code 09/320

T2 Telephone connection cable
A special telephone clip replaces the standard clip on the transmitter connection cable.

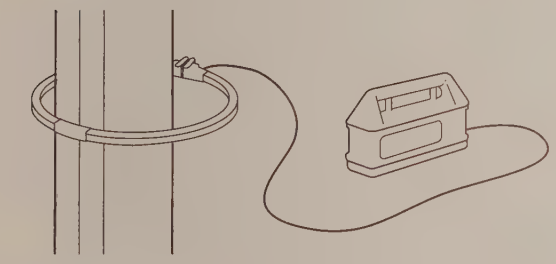
The clip is designed for use in telephone pedestals or cabinets. It has very small jaws, a pierce spike and a clamp pad.

Order code 10/RD4TEL

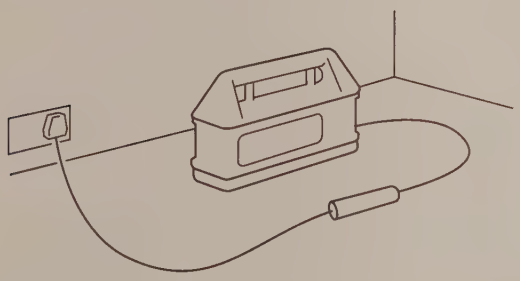
RD400 series Locator optional accessories



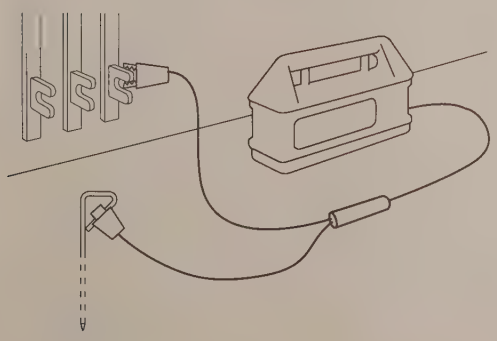
T3 Standard signal clamp



T5 Large signal clamp



T6 Plug connector



T7 Live cable connector

T3 Standard signal clamp

The Standard clamp applies the transmitter signal very selectively and effectively to a target cable up to 10cm/4in diameter at 8 and 33kHz or up to 75mm/3in diameter cable at 512Hz.

Both the Standard and the Small clamp have a double spring action for positive toroidal contact.

	Order code
8kHz/33kHz	10/RD4CLAMPD
512Hz	10/RD4CLAMP-512

T4 Small signal clamp

The Small signal clamp is useful for applying an 8 and 33kHz signal to a target cable in a pedestal or other place with limited space. The clamp is suitable for cables up to 5cm/2in diameter.

Order code	10/RD4CLAMPD2

T5 Large signal clamps

A 22cm/8.5in and a 39cm/15.5in clamp are available for applying the 8kHz or 33kHz transmitter signal to cables fastened to poles or situations where the standard clamp is too small. Each large clamp is supplied with 3m/10ft length cable.

Because of their size, large signal clamps are vulnerable to damage and should be handled with care.

	Order code
220mm 8.5m transmitter clamp	10/RD4GT0235
390mm 15.5in transmitter clamp	10/RD4GT0235-15

T6 Plug connector

The Plug Connector applies the 8kHz/33kHz transmitter signal to a live domestic power socket and via the domestic wiring system onto the service cable and the supply cable in the street.

The signal is applied between the live and ground conductors on a three pin plug. The connector can also be fitted with a 2-pin plug with the signal applied across live and neutral.

Both the user and the transmitter are fully protected from supply voltages up to 250V, DC to 60Hz.

	Order code
Two core plug connector	10/RD4PLC3

T7 Live cable connector

The Live Cable Connector applies an 8kHz/33kHz tracing signal safely to live low voltage cables. It is for use only by electrical personnel licenced or permitted to work on live cables.

The Live Cable Connector uses special fuses, clips and cable to comply with regulations.

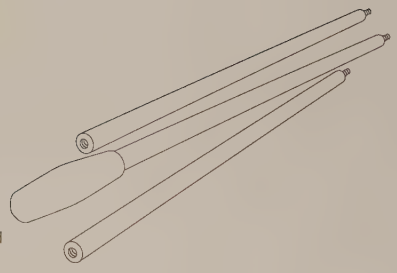
It is used to trace and identify cables and locate simple cable faults by connecting directly to a live conductor at a domestic cut out, street lamp, junction box or substation LV busbar.

Connection is normally made to the live conductor and the other lead is connected to neutral or ground as appropriate. When satisfactory connection is made, the transmitter loudspeaker tone changes.

The user and the transmitter are fully protected from supply voltages up to 500V, DC to 60Hz.

Order code	10/RD4LCC

RD400 series Locator optional accessories



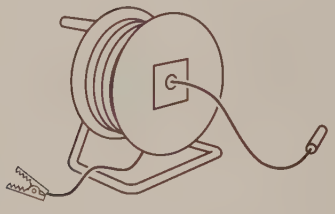
T8 Extension rod

T8 Extension rod
A 60cm/24in rod to extend reach for clamping to inaccessible cables or to cables in flooded chambers.

Up to three rods can be joined together to give an extended reach of 180cm/72in.

The rod is threaded to accept the 8 and 33kHz Standard and Small Signal Clamp, the Clamp Antennas and the Small Stethoscope Antenna.

Order code 10/EXT



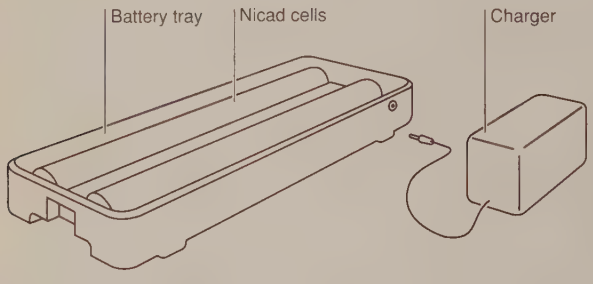
T9 Cable reel

T9 Cable Reel
A 200m/220yd cable reel for a remote ground or a double-ended connection.

Order code 10/RD0107

T10 HPTx vehicle power cable
An alternative to the external supply lead, this accessory is fitted with a plug that fits into vehicle cigarette lighter sockets.

Order code 09/41910-2



T11 Rechargeable batteries

T11 Rechargeable nickel cadmium batteries
The replacement battery tray is permanently fitted with rechargeable cells. Cells are charged via an integral power socket which must only be used with the matching charger.

Cells can be charged without removing the battery tray but cannot be used whilst charging. If the transmitter is used frequently, a second rechargeable battery tray is recommended; one is in use while the other is charging. Battery life is 40% of standard alkaline battery. 16 hour charging time. The set comprises a complete battery tray and a dedicated AC charger.

	Order codes
Batteries in tray and 240V charger	10/10XD240SET
Batteries in tray and 110V charger	10/10XD110SET
Batteries in tray	10/10XDNICAD

RT1 12V rechargeable battery system
An alternative to the 240/110V chargers, this accessory is fitted with a plug that fits into vehicle cigarette lighter sockets.

The charger can charge both receiver and transmitter NiCad batteries; receiver battery packs are plugged into the side of the charger and the transmitter batteries remain in the tray.

Order code 10/RXTX12V

RT2 Rigid carry case

RT2 Rigid plastic carry case
An alternative to the padded bag, for RD400 series receiver, transmitter and accessories.

See order code in Section A if rigid carry case is required in place of the carry bag on new kits of equipment.

Order code 10/RD4CASE

Radiodetection make every effort to ensure that information about locating equipment and its use is correct but do not accept responsibility for damage or problems caused through use of the equipment: priority must always be given to following national and local safety requirements. We are continually developing our products and the design of Radiodetection equipment is subject to change without notice.

Printed in UK 90/RD400B/ENG/3 7.91

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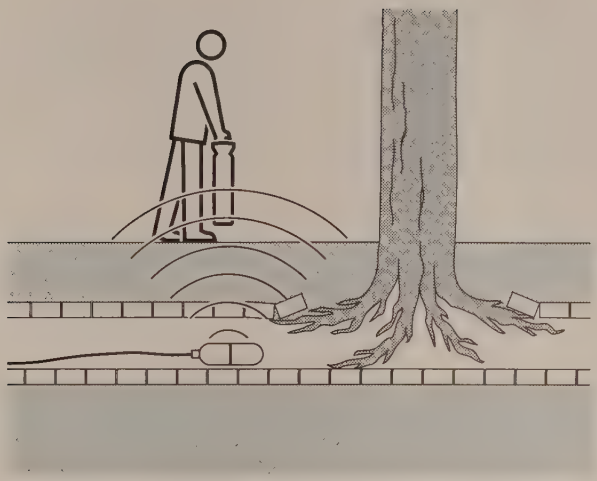
Section C

Sondes for tracing drains, ducts and for other applications



Transmitting Sondes enable RD400 series receivers to trace non metallic sewers, drains, ducts or pipes and to locate blockages or collapses. Sondes can also be incorporated in No-Dig tools to monitor progress and they can be used to solve a large number of different underground problems.

A wide range of transmitting sondes are available to suit different applications.

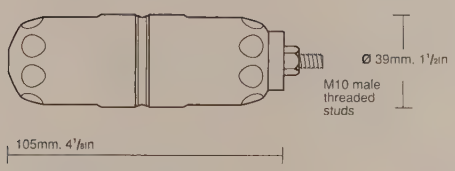
Sondes are used in applications involving vibration and shock. In order to ensure that they will withstand this treatment, each sonde is shake tested on a custom built vibrating table before its final performance check.

A range of special sondes and sonde elements are available for fitting to horizontal boring tools, CCTV inspection cameras and other No-Dig equipment and are listed separately.

Most sondes are available in a choice of two frequencies. Check that the transmitting frequency corresponds to the receiver frequency.

C

Transmitting sondes



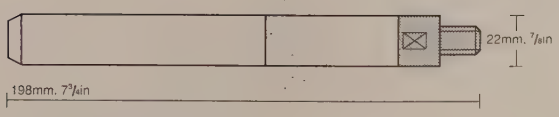
Standard Sonde

Standard Sonde

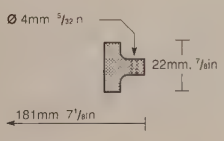
Standard Sonde combines compact size with a strong signal. The standard for most applications unless a smaller size, greater depth or specially rugged construction is required.

Location depth:	5m/*16ft*
Weight:	190g/*7oz*
Signal:	continuous
Battery:	1 x AA alkaline (IEC code, LR6) 20 hours life

	Order codes
8kHz:	10/SC0412-8
33kHz:	10/SC0412-33R



Slim Sonde with M10 stud end cap



Plain end cap

Blank end cap

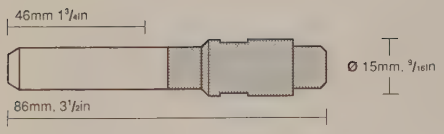
Slim Sonde

The long shape is designed for attaching behind soil piercing tools and other underground tools. Not suitable for use in sewers or applications where its length makes it susceptible to damage. The M10 stud end cap is supplied as standard.

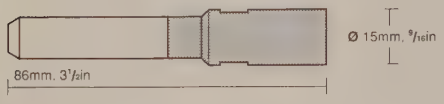
Location depth:	max 3.5m/*12ft*, min 0.5m/*20ins*
Weight:	220g/*8oz*
Signal:	continuous
Battery:	1 x AA alkaline (IEC code, LR6) 12 hours life

	Order codes
8kHz:	10/SD0322-8
33kHz:	10/SD0322-33R
Plain end cap	10/SD0223
Blank end cap for customer machining	10/SD0268

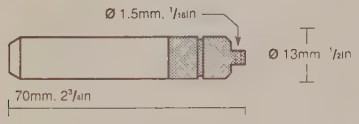
Sondes for tracing drains, ducts and for other applications



Small Sonde with M10 stud end cap

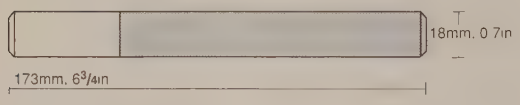


Blank end cap

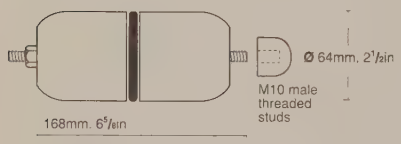


Plain end cap

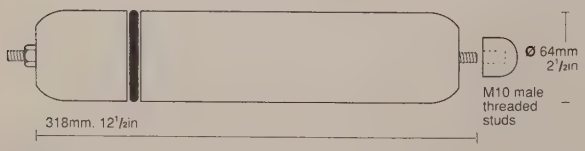
Super Small Sonde S18A



Super Small Sonde S18B



Sewer Sonde



Super Sonde

Drawings not to scale.

Small Sonde

Small size and limited range makes it suitable for use in small pipes at shallow depths. The M10 stud end cap is supplied as standard. Fitting the plain end cap reduces sonde diameter to 13mm/½in.

Location depth:	1.5m/*5ft*
Weight:	60gm/*2oz*
Signal:	continuous
Battery:	2 x Duracell RM 13H Varta 4013 or Ray-0-Vac R13 (IEC code, NR48) 6 hours life

	Order code
33kHz:	10/SE0323-33R
Plain end cap	10/SE0249
Blank end cap for customer machining	10/SE0272

Super Small Sonde

Specialized sonde particularly suitable for No-Dig applications. A feature is interchangeable battery housings so that length can be altered at the expense of battery life.

Location depth:	4.0m/11ft
Signal:	continuous, 33kHz only
Batteries:	S18A: 2 off SP675 (IEC, NR44), 20 hours life S18B: 2 off AA (IEC, LR6), 60 hours life

	Order code
33kHz, S18A:	10/S18/82-33-000
33kHz, S18B:	10/S18/173-33-000

Sewer Sonde

Very strong enclosure suitable for the most abrasive and rugged duty in municipal sewer systems. The Sonde has a long life for daily use in all conditions.

Location depth:	max 8m/*26ft,* min 0.5m/*1.5ft*
Weight:	0.5kg/*1lb*
Signal:	continuous or pulsed. Reversing battery polarity changes signal
Battery:	9V alkaline (IEC, 6LR61) 15 hours life

	Order code
8kHz:	10/SA0337-8
33kHz:	10/SA0337-33R

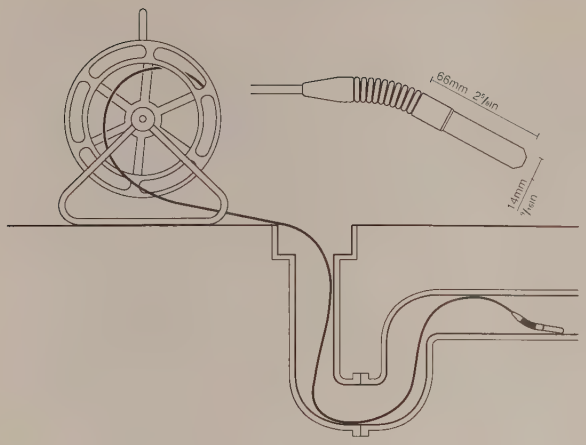
Super Sonde

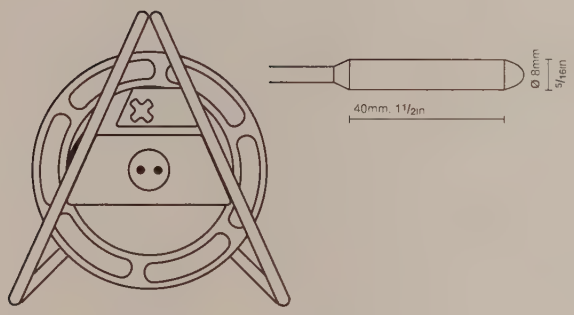
Strong construction designed for use in deep sewers.

Location depth:	max 15m/*50ft,* min 3m/*10ft*
Weight:	0.9kg/*1¾lb*
Signal:	continuous or pulsed. Reversing battery polarity changes signal
Battery:	9V alkaline (IEC, 6LR61) 5 hours life

	Order codes
8kHz:	10/SB0338-8
33kHz:	10/SB0338-33R

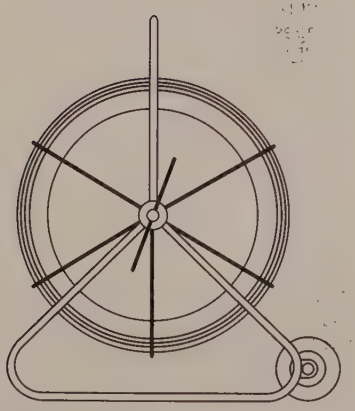
Sondes for tracing drains, ducts and for other applications





FlexiTrace

Length m/ft:	50/160
Weight kg/lb:	6/13.2
Order codes:	10/TRACE50



F60 and F120 Flexrods

FlexiSonde

The transmitter of the FlexiSonde is fitted with a spring mounting directly to a flexible rod.

The FlexiSonde is specially designed for tracing buried small bore plastic pipe at depths down to 1.5m/5ft. The small size of the transmitting head, the spring mounting and the flexibility of the 5mm/$^{3}/_{16}$in rod makes the FlexiSonde suitable for inserting into plastic pipes as small as ø 25mm/1in and with a minimum radius of 15cm/6in.

Performance and batteries are same as the Small Sonde.

Length m/ft:	50/160	80/260
Weight kg/lb:	4.5/10	5.5/12
Order codes:	10/MF50M33K	10/MF80M33K

FlexiTrace

The Radiodetection FlexiTrace is a traceable plastic covered fibre glass rod incorporating wire conductors and is for locating small diameter non-metallic pipes and ducts down to 3m/10ft depth.

The FlexiTrace can be inserted into a pipe or duct as small as 12mm/0.5in i.d. with a minimum bend radius of 250mm/10in.

The FlexiTrace does not require batteries and is energised by any Radiodetection transmitter and located with a compatible receiver.

The transmitter can be connected to the two stud terminals to energize the FlexiTrace transmitting head so that it can be pinpointed. Alternatively the transmitter can be connected to a stud and ground so that the whole length almost to the head is energized for speedy tracing.

An optional carry case is available to prevent contamination which is recommended when the FlexiTrace is being used for insertion into potable water.

Accessories for Sondes

FlexRods

The Radiodetection FlexRod is a plastic rod for pushing a transmitting sonde into and along a sewer or duct for distances up to 120m/390ft. The rod is coiled on a special rotating steel caged spool and is unwound from the spool and fed down the drain. The rod straightens out as it leaves the spool and is sufficiently rigid for its entire length to go down the drain. It bends to go round corners and curves.

The FlexRod is a glass fibre rod in a polypropylene sleeve and is resistant to abrasion, most solvents, oils and acids. It is suitable for bending to a minimum radius of 250mm/10in.

Each end of the FlexRod is fitted with a brass female M10 x 20mm/$^{3}/_{4}$" threaded collar 62mm/2$^{1}/_{2}$" long suitable for fitting to sondes. In the event of the collar at one end becoming damaged the FlexRod can be reversed on its spool and the other end used for attaching the sonde.

The FlexRod is attached to the spool via a standard spring coupling so that the rod will not break if it is rapidly completely unwound.It is also fitted with a brake to help the user maintain control of the rod.

Sondes for tracing drains, ducts and for other applications

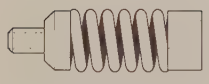
F30 Flexrod

C

Three sizes of FlexRod are available:

Type:	F30	F60	F120
Length m/*ft:*	30/*98*	60/*196*	120/*390*
Rod diam mm/*in:*	9/$^3/_8$	9/$^3/_8$	9/$^3/_8$
Spool diam mm/*in:*	600/*24*	800/*32*	800/*32*
Weight kg/*lb:*	9/*20*	24/*53*	34/*75*

	Order code
F30	10/FLEXRODF30
F60	10/FLEXRODF60
F120	10/FLEXRODF120

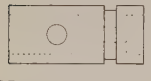


Spring coupling

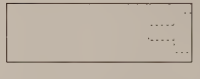
Wards 8mm connector

Plastic or cane rod connector

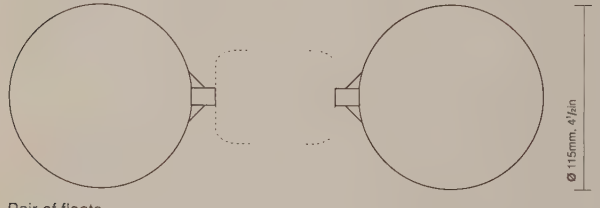
Wards 6mm connector



GD connector



Blank connector



Pair of floats

It is preferable to fit a spring coupling (see over) between the end of the the FlexRod and the sonde. Using the coupling reduces shock to the transmitting sonde when it hits the walls of the drain or pipe and it can often ease the sonde round bends and corners. It is particularly useful for starting the sonde round the sharp change of direction at the bottom of a deep chamber.

The FlexRod can be used in the place of ordinary drain rods for many applications. It can be fed into the drain and withdrawn more easily than rods but it cannot be rotated. An adaptor (order code 10/FR0336) to fit the FlexRod's M10 threaded end is available. The other end of the adaptor is blank for tapping or machining by the user to fit his tool or appliance.

Also available:	*Order code*
Pulling eye with 3.5mm dia hole	02/FR0819
Coupler for joining two FlexRods	02/FR0818N1

Sonde connectors and couplings

All connectors and couplings have female M10 thread to screw on to Sondes.

Order code

Spring coupling
M10 male to match connectors. The spring coupling should be used for attaching sondes to the FlexRod or to drain rods. 10/SU0335

Plastic or cane rod connector
male thread 02/SU0339

GD connector
$^3/_4$" x 12 BSF female 02/SU0340

Wards 8mm connector
$^3/_4$" x 10 BSW female 02/SU0341

Wards 6mm connector
$^1/_2$" x 12 BSW 02/SU0342

Blank connector
for machining by customer 02/SU0343

Pair of floats
Sewer and Super Sonde only 10/SU0334

Telecom duct rod Nos. 1 and 2
Connector has 0.717" dia, 7TPI Whit. male thread and hole to match latching mechanism. 02/SU0401

Telecom duct rod No. 3
Connector $^3/_4$" dia. 10TPI Whit. male thread and nylon stud locking system. 02/SU0402

Telecom duct rod No. 5
Connector has 7/16 BSW male thread and hole to match latching mechanism. 02/SU0403

Radiodetection make every effort to ensure that information about locating equipment and its use is correct but do not accept responsibility for damage or problems caused through use of the equipment: priority must always be given to following national and local safety requirements. We are continually developing our products and the design of Radiodetection equipment is subject to change without notice.

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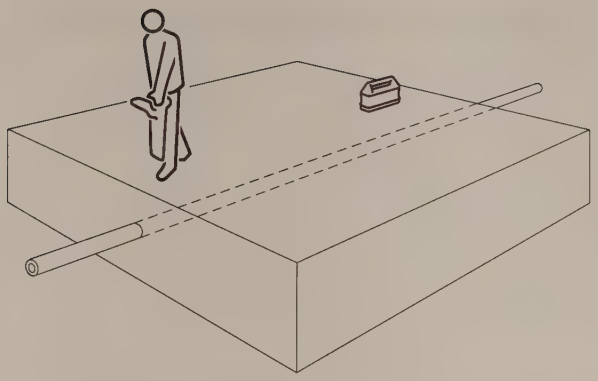


1 Introduction

1.1 Using an RD400 series locator

The RD400 series locator is a simple unit comprising a transmitter and a receiver. Although simple, it is often used to define complex locating problems in confused situations and this is the reason for the large variety of possible ways of using the equipment. Information in this manual combined with field experience will help select the most suitable method to obtain the best results.

The locator is an aid to locating buried lines. It provides information to which must be added experience and local knowhow to provide reliable and accurate information about the position and depth of buried lines.

Obtaining site plans or contacting the local utilities before locating is mandatory in some areas and is always advisable. Information thus obtained may not be accurate or complete but it usually warns what to expect.

A large number of optional accessories are available with RD400 series locators to increase their usefulness and to widen their scope. Review the accessories in Section B and C and check if they can help get the locating job done more efficiently.

A knowledge of the theory of electromagnetic principles is useful and helps the user to take full advantage of the RD400 series locator and to recognise its limitations. Locator users are recommended to read Radiodetection's publication 'The Theory of Buried Pipe and Cable Location'.

A Radiodetection locator is different from other locators. It provides very accurate information about the position and depth of buried lines. This manual gives full information about how to obtain results from the locator. Work through the relevant sections of the manual and spend time familiarizing yourself with the techniques for locating and tracing buried pipes or cables before being asked to locate to provide critical and important information.

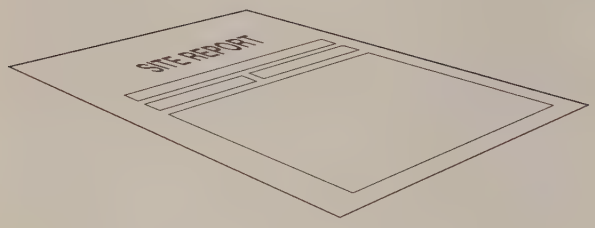
No organisation can afford the cost of faulty information resulting from ineffective use of a locator. Become expert at using the locator to provide accurate information, the only information worth having.

1.2 Safety

Safe working on site is always the first priority and must never be neglected. Any electrical apparatus has its potential dangers and Radiodetection locators are no exception. The locators must only be used with strict observance of standard safety procedures.

Specialized procedures such as applying a transmitter signal directly to a live power cable conductor or inserting sondes into pressurized pipes must only be undertaken by licenced or qualified personnel.

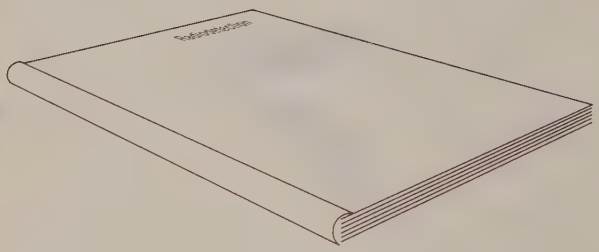
Locators are often used in the highway where there are dangers of passing traffic: always be prudent and remember 'safety first'.



1.3 Reporting

Sometimes there are situations when it is not possible to pinpoint a target, or to identify a line or provide correct information about a buried line. Experience will help the user decide on the quality of information obtained using the locator. This information can often be corroborated with aids from the site: visual indications of buried plant, site or system drawings etc.

Any doubts about the precision or the correctness of locating information must always be included in reporting or staking out.



1.4 Using this manual

The first part of this manual gives comprehensive information on the RD400 locator and its accessories.

A Technical information about the RD400 series locator.

B Detailed information about optional accessories for increasing the usefulness and extending the scope of RD400 series locators.

C Information about the range of transmitting sondes and accessories for use with RD400 series locators.

Additional information, not in this manual, is available.

D Locator parts lists, exploded drawings, servicing and calibration instructions.

The second part of this manual is divided into sections:

2 Glossary defines technical terms found in the manual and that are generally used when locating.

3 Locating buried lines - details the basic techniques of locating, tracing and pinpointing buried lines. It also describes procedures for searching an area for buried lines.

4 Applications - describes how to use RD400 series locators to locate different types of buried utility plant and how to conduct a survey.

5 Using transmitting sondes - procedures for locating non metallic sewers, drains and pipes. It also details procedures for finding leaks in plastic water pipes, joints in iron gas pipes and procedures for monitoring No-Dig tools and instruments.

6 CM Current Measurement

7 CD Current Direction Recognition

These Sections may not be included in the manual if they are not relevant to the locator described in Section A.

1.5 Care of an RD400 series locator

The RD400 design has no parts which need regular replacement or servicing. If an instrument requires maintenance, please refer to Radiodetection for details of local repair facilities.

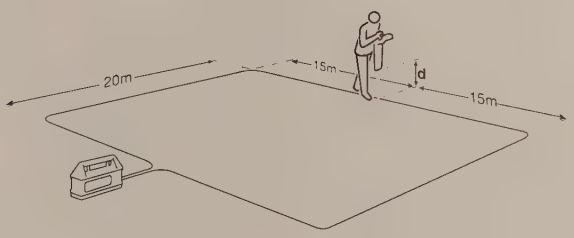
1.5.1 Safety Testing

If passive modes (Power, Radio) are used in a safety application such as cable avoidance, it is good practice to undertake regular checks to confirm correct function.

The best and most reliable technique is to undertake a 'street' test. Familiarize yourself with the instrument and use it to detect some cables at convenient locations close to the workshop or depot.

Choose one or two sites where the Power and/or Radio signals give a consistent response and use these as benchmark test sites. Ideally, try to find sites where the Power/Radio signal is relatively weak, i.e. where the line can only be found with the sensitivity control at, or near, maximum - any significant loss of performance can then be readily noticed.

1.5.2 Depth Check



Note that reliable, accurate depth measurement is only certain when a good active signal is present on a single line; there must be no significant signal on adjacent lines and the target line must be straight and without tees for about ten paces to either side of the receiver. Also, depth will not be accurate if measured within 20 paces range of a transmitter switched to induction.

If a suitable line - without the problems mentioned above - is available whose depth is known at a particular point, use it as a benchmark test site to undertake regular checks.

Alternatively, an above ground test loop can be used.

Choose an area known to be free of buried pipes/ cables and metal structures.

Lay out a test loop as illustrated.

It can be used to verify depth accuracies in the range 20cm/8" to 2m/6'6".

1.5.3 Cleaning

Do not use solvents for cleaning; they attack and damage parts of the plastic housing. If it is necessary to remove mud or grime, use a sponge dampened with warm water. A mild soap may be used to loosen engrained dirt.

Periodically wipe the moving coil meter or liquid crystal display window with an anti-static fluid.

The RD400's construction incorporates weather-proof seals but they are not guaranteed to prevent water ingress if immersed in water.

1.5.4 Batteries

Radiodetection recommends the use of Alkaline Manganese batteries. They are generally more cost-efficient than other types. Cheaper Zinc-Carbon types can be used but they will give a much shorter battery life, possibly 75% less than Alkaline cells.

Never change only some of the batteries - all or nothing is the rule.

Be careful to observe the correct polarity. The instruments are protected against being damaged by incorrect polarity but they will not work unless the batteries are inserted correctly.

Types	Receivers	Standard * Transmitters	High Power Transmitters
Quantity	12	10	10
Description	AA 1.5V Alkaline	AA 1.5V Alkaline	D 1.5V Alkaline
IEC Code Mallory	LR6	LR6	LR20
Duracell	MN1500	MN1500	MN1300
Fuji	5300	5300	5100
USA - EverReady	E91	E91	E95

* AA cells are a low-cost option for Standard Power

Transmitters. The batteries are fitted inside the two reducer tubes. Alternatively, the tubes can be discarded and the High Power Transmitter battery types can be used. This does not increase output power but gives a longer and more cost-effective battery life.

1.5.5 Transmitters/fuses

Battery Trays. A fuse is fitted to protect the unit against a short-circuit. It **will** blow if the battery tray terminals are inadvertently short-circuited.

If necessary, replace it with a 2A, quick-blow 1.25" fuse.

In normal use, the fuse will only fail if the transmitter has developed a fault; do not replace the fuse - arrange to have the unit repaired.

Output Fuse. Some High Power Transmitters have a fuse to protect the output lines in case of inadvertent connection to conductors that have an excessive voltage.

The output fuse is fitted next to the connection socket.

If a transmitter fails to work in Connection mode, but works in Induction, check the output fuse.

Replace with a 315mA quick-blow fuse.

2 Glossary

Certain terms are used. It is important to know their meaning in the context of this book.

Active signal: a signal applied to a line with a Radiodetection transmitter.

Cable sheath: a conductive layer usually surrounding the working conductors to provide electrical screening. Usually isolated from ground by a further layer of plastic or other insulator. The sheath is generally terminated to a ground connection at the end of a cable length.

Coupling: when a signal applied to the target line transfers to other nearby lines.

FaultFind: to pinpoint the plan position of a sheath fault.

FaultFind signal: the detectable ground current flowing as a result of connecting a FaultFind transmitter to a cable sheath with a fault to ground.

Line: continuous buried metal pipe or cable or other conductor capable of carrying an electric current.

Meter: a visual display to indicate response when the receiver detects a signal. Some receiver types are fitted with a moving needle meter. On others the meter is shown on the lower part of the liquid crystal display.

Pace: unit of measurement approximating to a metre or yard.

Passive signal: a signal that occurs 'naturally' on a buried metal pipe or cable such as 50/60Hz energy or VLF radio energy.

Pinpoint: using the locator receiver to establish the exact position of a target line.

Precision locator: a locator having horizontal aerials to give a peak response and a vertical aerial to give a null response.

Precision pinpoint: using different locate modes to confirm the precision of a pinpoint.

Rebars: concrete reinforcing mesh.

Response: the indication on the receiver visual display or from the loudspeaker when the receiver detects a signal. The response can be varied for a given signal by adjusting the receiver sensitivity level.

Search: using the locator to find all buried lines in an area.

Shealth fault: damage to the insulation surrounding a cable sheath such that there is an unintentional conductive path enabling current flow between sheath and ground.

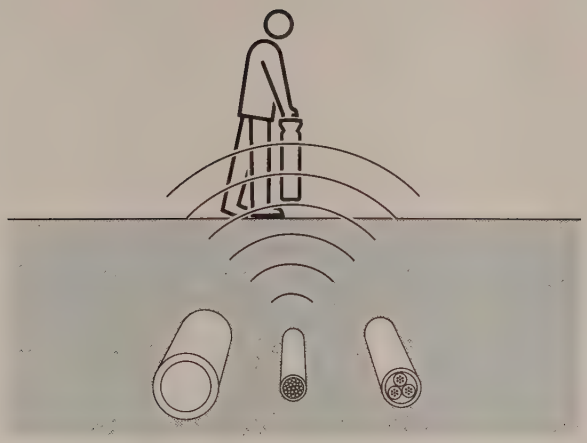
Signal: a flow of alternating electric current on a line resulting in a detectable magnetic field.

Sonde: a self-contained waterproof battery powered transmitter whose signal can be located by the receiver. Sondes are commonly used for locating non-metallic drains or ducts or for monitoring No-Dig procedures.

Sweep: using the receiver to locate lines radiating active or passive signals. Sweeping an area is usually done in an orderly grid pattern to cover the whole area.

Target: a target line is a selected metal pipe or cable to which the transmitter signal has been applied and which is to be traced and pinpointed with the receiver.

Trace: using the receiver to follow the route of a line.

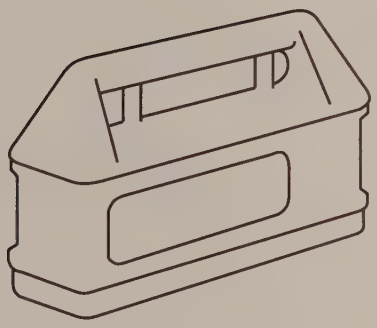


3 Locating buried lines

A buried line is located and traced by applying the distinctive transmitter signal to it and then tracing it with the receiver.

The receiver's Power and Radio passive modes are for searching an area for unknown power cables and other lines and the transmitter signal is traced by the receiver on its active mode or modes.

3.1 Applying transmitter signal to trace a target line



The transmitter is used to apply an easily identified signal to a target line for it to be traced, identified and pinpointed using the receiver. A number of different application techniques are available for use in different site situations and the user must choose the technique that applies the best signal with minimum coupling. Field experience or the trial and error of working through the application techniques determine the best method to apply the transmitter signal.

3.1.1 Transmitter controls

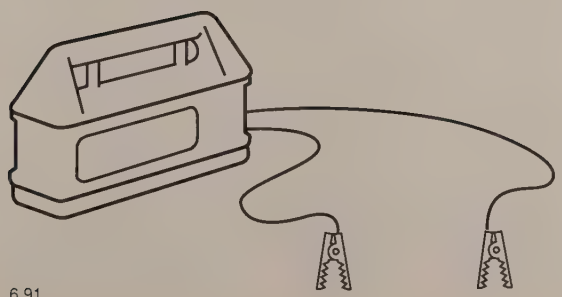
Output level control. Always use the lowest signal level that gives adequate tracing signal; this saves battery power and reduces the effects of coupling.

Start locating with the control set to Normal but reduce it to Low if possible. Only use High when extra tracing range is required or for applying the signal to deep target lines.

High Power Transmitters also have an impedance match switch. Level 1 is adequate for most tasks. When selecting higher levels, listen for the speaker tone change; it should change to a lower tone but may not if connected to a good quality circuit. For best signal, and battery economy, turn to the switch position which gives the lowest tone.

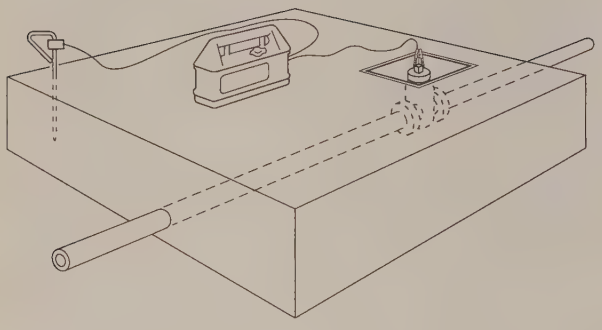
Some transmitters offer a choice of frequencies. Always check that transmitter and receiver are at the same frequency.

3.1.2 Connection



Advantages: target line can be positively identified at application point. Suitable for use on continuous tracer wire, water and gas distribution systems or on a telecom pair or on a power cable sheath (only to be applied by qualified personnel) or to a pipeline at a CP test point or other access point.

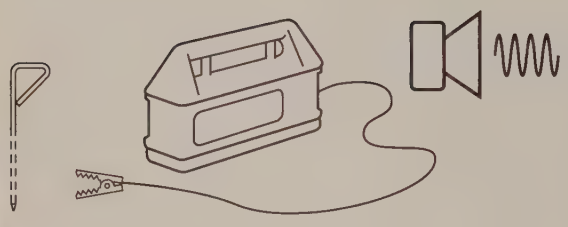
Disadvantages: None: however sometimes difficult to apply to corroded valves or lines and cannot always be applied safely to the conductors of an electrical cable. (see 3.5.5)



Procedure
Plug the connection cable into transmitter output socket and connect to target line. If necessary clean off paint, rust or scale to make good electrical contact.

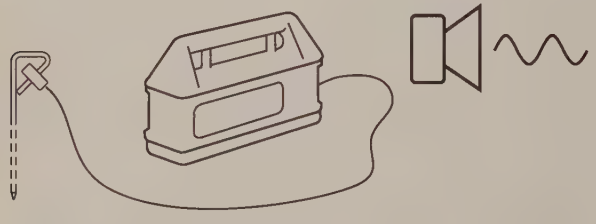
Clip the ground cable to an independent grounding point 4 or 5 paces distant and preferably at right angles to the probable route of the target line and plug into the green transmitter socket. Do not attach ground cable to a water pipe or other buried line which would then carry the transmitter signal.

Change in loudspeaker tone indicates that a circuit has been completed from the transmitter along the target line and back through the ground return. Check tone change by disconnecting clip and reconnecting.

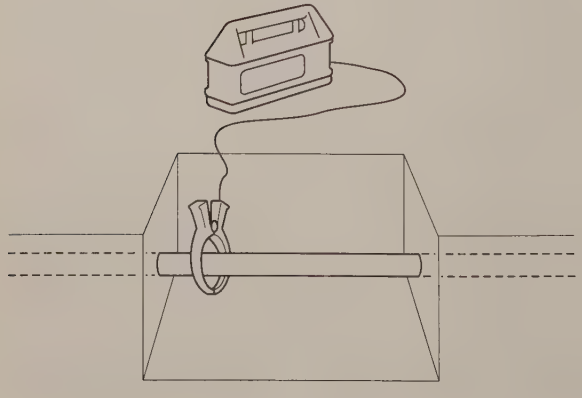


When there is no tone change from the transmitter: check electrical contact to the target line and check ground. If necessary change position of ground or tip water over ground contact in dry soil or sand.

A tone change on the transmitter indicates a good connection and that a strong signal has been applied to the target line. However, the receiver can detect a signal many times weaker than that necessary for a transmitter tone change and satisfactory short distance traces can often be made without a tone change.



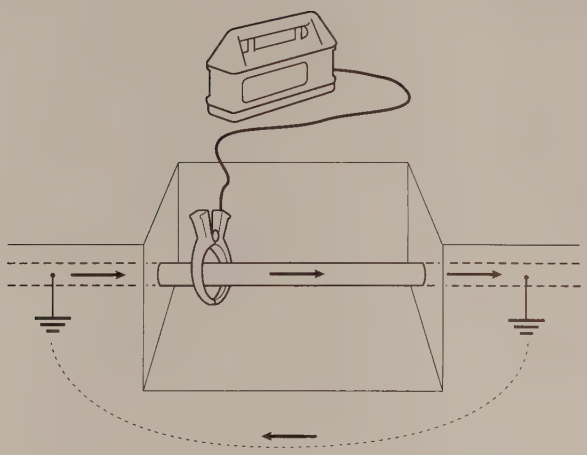
3.1.3 Clamping the transmitter signal



Radiodetection supply a range of clamps with 5cm/2", 10cm/4", 22cm/8.5" and 39cm/15.5" internal diameters as optional accessories to apply the transmitter signal to a cable or pipe. The standard 10cm/4" clamp is suitble for most applications. The 5cm/2" is for use in telecom systems and the larger clamps are for applying a signal to a pipe or to a cable running down a lighting column or similar.

Advantages: the clamp safely applies a signal to a live cable without interrupting the supply. It applies a very discriminating signal to a target line with reduced coupling. It is very simple to apply.

Disadvantages: clamp signal may not travel as far as a connected signal. The target line should be grounded at each end.



Procedure
Plug the clamp in to the transmitter output socket.

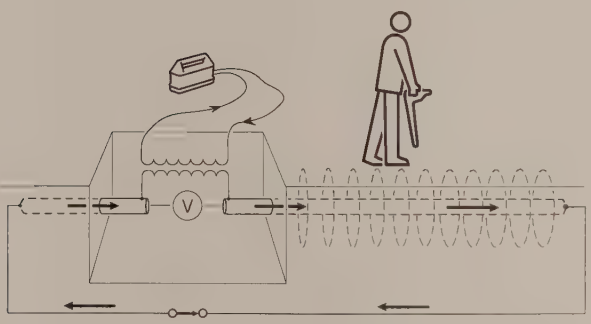
Put the clamp around the pipe or cable, making sure the jaws are closed and switch on the transmitter.

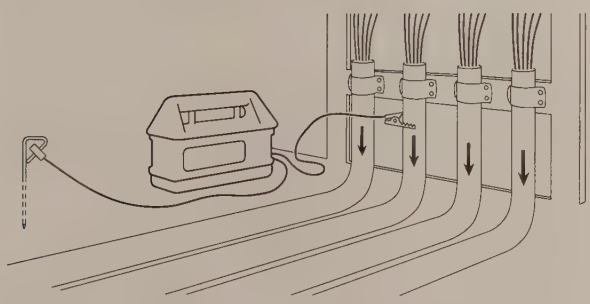
The line should be grounded on each side of the clamp for the signal to transfer to the line. Make a ground connection if necessary.

The clamp may buzz or vibrate if around a power cable with significant nett current flow. This is normal and will not harm the equipment. Do not touch the exposed pins of the plug when the clamp is around a power cable.

An insulated cable may be traced even if it has no actual ground connection providing a reasonable length is buried to either side of the clamp to provide capacitive coupling to ground.

Do not make a ground connection from the transmitter when using the clamp.

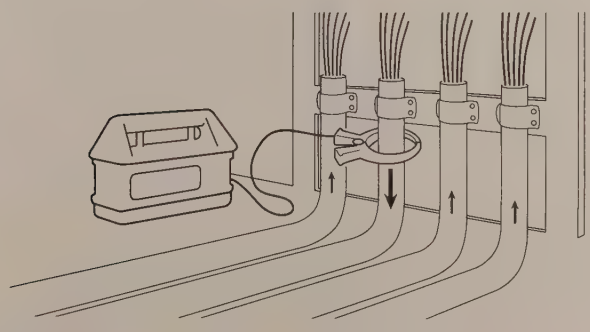




This provides a unique advantage when dealing with multiple lines that are mutally bonded:

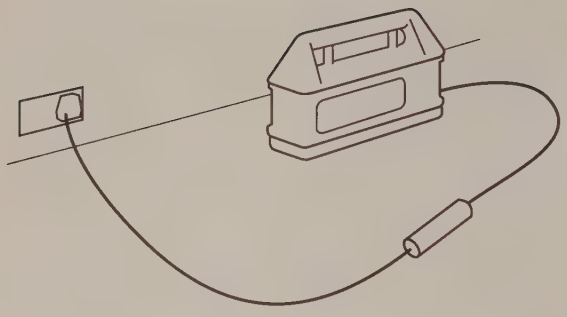
The clamp can be more selective than connection in many situations because it works as if the line has been cut and the transmitter connected between the cut ends.

When connecting to mutually bonded lines, the signal will flow on whichever line happens to present the easiest path; not necessarily the one to which the clip is applied.



Using the signal clamp, the target line must carry the strongest signal - the other lines will carry the weaker return signal.

Note that if the system comprises only two conductors they may carry equal signals.



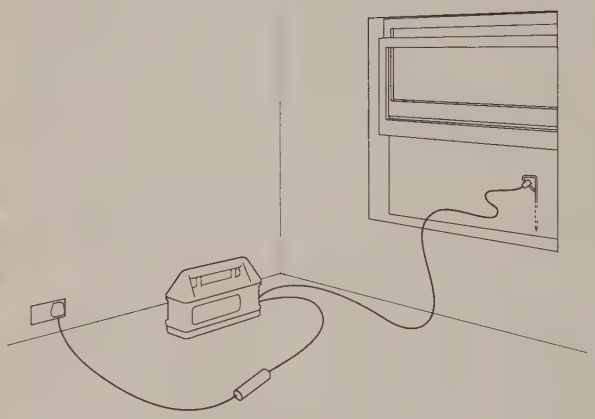
3.1.4 Applying the transmitter signal with the plug connector

The plug connector is an optional accessory to apply the transmitter signal to a live domestic power socket and via the domestic wiring system onto the service cable and the supply cable in the street. The signal should be detectable on the supply system a few hundred paces each side of the point of application.

Advantages: applies a very selective signal to a power cable. The most certain system to locate a power distribution system in the street.

Disadvantages: entry to domestic or other premises is necessary to apply the plug connector.

Procedure
Insert the plug connector to the transmitter output socket and fit the plug to a live domestic power socket. Socket must be live for signal application: switch on socket.



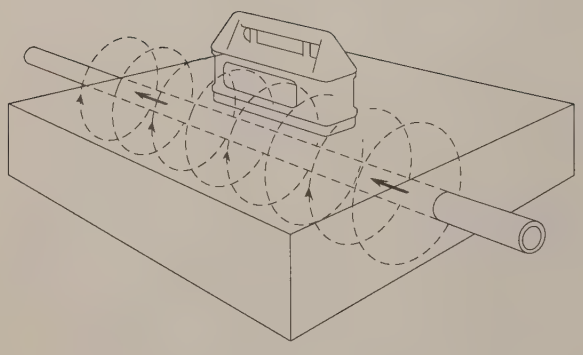
The plug connector incorporates a protection unit which includes a filter, isolating transformer and fuse to protect the user and the transmitter from mains voltage up to 250V.

The signal is applied between the live and ground conductors on a 3 pin plug and between live and neutral on a 2 pin plug.

Use of a 3 pin plug gives better results for maximum tracing distance and reduced coupling.

On two-wire Protective Multiple Earth (PME) systems, with no local domestic earth connection, the plug connector signal may not be detectable. Use the ground cable to make a remote ground connection and these cables can then be located.

Supply systems fitted with ELBCs/RCDs (Earth Leakage Contact Breakers/Residual Current Devices): The Plug Connector by itself does not draw enough current to trip the services but may add to existing earth leakage to cause a trip. *Avoid using the 3 wire plug connector on critical systems.*

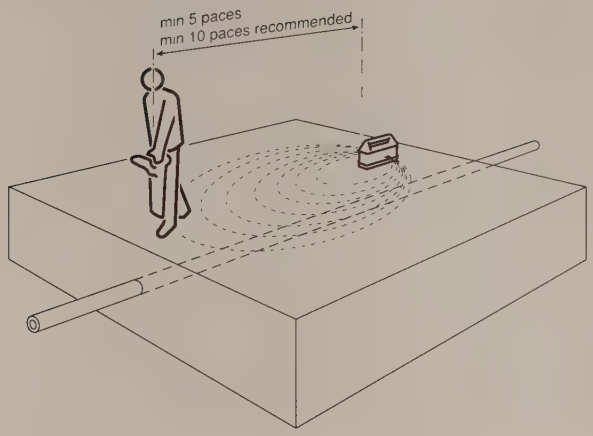


3.1.5 Induction

The transmitter includes a loop that will induce a signal to a line directly below the transmitter. It's efficiency is poor on deep targets. Generally, only useful at depths down to 2m/ 6ft.

Advantages: signal can be applied without access to the line. Very simple and quick.

Disadvantages: the signal can induce onto nearby lines as well as the target. Part of the signal strength is lost in surrounding soil. Receiver cannot be used within a minimum of 5 paces from transmitter, and often much further if maximum transmitter power is being used from transmitter. It will not apply a signal to a well insulated line unless it is effectively grounded at each end.



Procedure
Switch on the transmitter and place it directly above and in line with the buried pipe or cable.

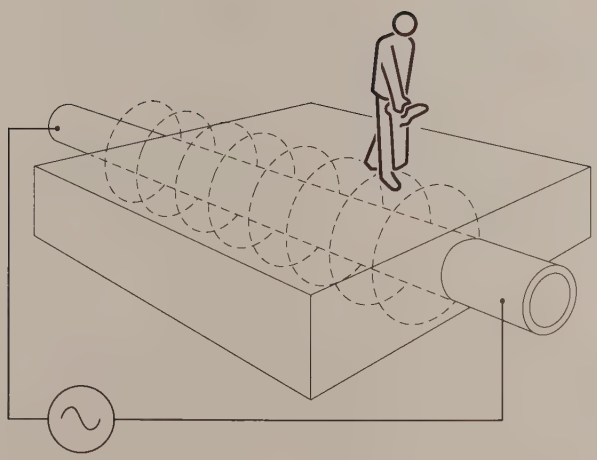
Turn down sensitivity of the receiver to minimum and start locating the line at least 10 paces distant from the transmitter.

Precautions
The transmitter radiates a signal into the atmosphere as well as onto the line and this may cause problems when trying to work close to the transmitter. To check that the receiver is locating the line rather than picking up the transmitter signal directly, move the transmitter a pace or two to one side. If the line appears to move too it indicates that the receiver is too close to the transmitter. Another method is to point the receiver directly at the transmitter. If the response is the same or increases it indicates that the receiver is picking up airborne signals. If this is the case transmitter power should be reduced and receiver sensitivity reduced. It may be necessary to move the receiver as much as 25 or 30 paces from the transmitter.

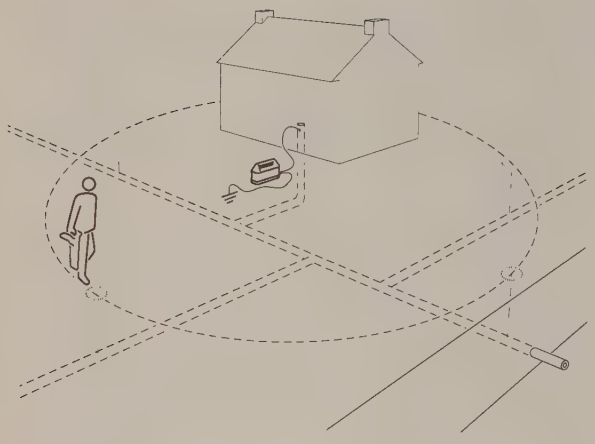
Induction cannot be used to apply a signal to a line below reinforced concrete.

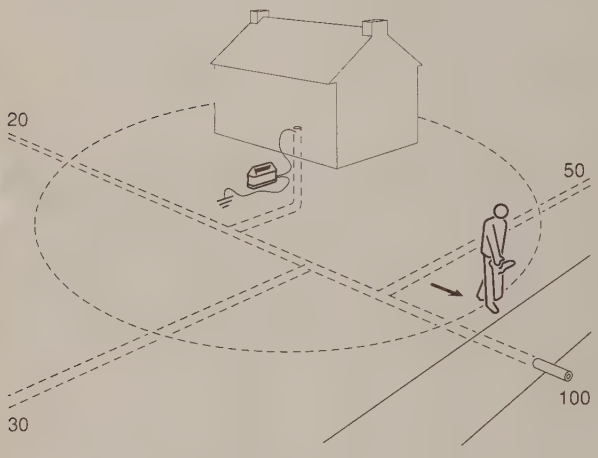
3.2 Tracing a target line with the receiver

The receiver is used to trace a target line once a transmitter signal has been successfully applied to it. Power and Radio signals present on a line are almost certainly present on other lines so the target line can only be reliably traced once the transmitter signal has been applied.



The receiver gives two responses. The meter gives the most exact response to the signal from a line. The audio response enables the ear to distinguish the desired signal on the line from unwanted interference.





3.2.1 Check the batteries before use. check that receiver and transmitter are the same frequency.

Precision receivers with peak and null responses should be switched to peak unless otherwise noted.

3.2.2 First, it is necessary to locate the line that is to be traced. Walk at least 4 paces from the transmitter if the signal is connected or clamped to the target line and at least 10 paces from the transmitter if it is inducing its signal to the line.

Hold the receiver at comfortable arms's length, turn sensitivity fully clockwise to maximum.

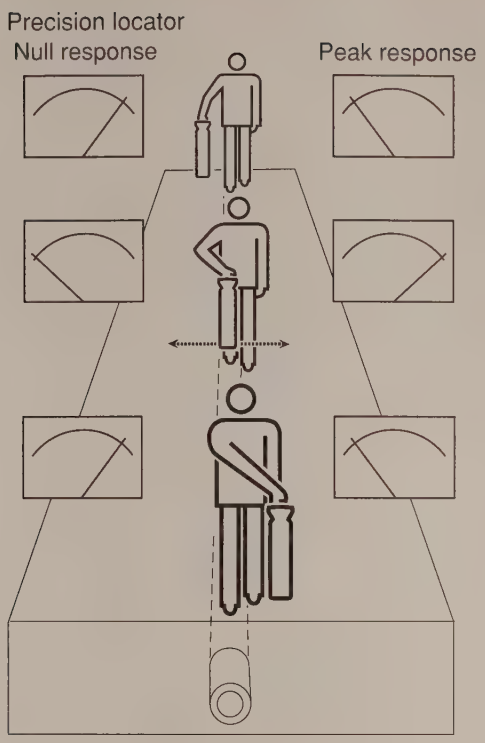
With the flat of the receiver detection blade facing the transmitter, walk in an arc around the transmitter. Reduce sensitivity as necessary to keep meter on scale.

3.2.3 Stop at the point where the meter registers a peak response. Move the receiver from side to side to establish the exact position of the response. Place the end of the receiver blade on the ground, again adjusting the sensitivity control to keep the meter on scale.

Mark the spot and note the meter reading.

Continue the arc round the transmitter with the detection blade facing the transmitter and sensitivity turned up so that meter indication is near top of scale. Stop each time there is a response, reduce sensitivity to give a narrow response, determine the position of the line, mark it and note the meter reading.

It the receiver locates more than one signal, compare meter reading of each signal. The strongest signal will almost certainly be the target to which the transmitter signal has been applied.



3.2.4 Hold the receiver over the target line. With the detection blade at right angles over the line and holding the receiver comfortably, adjust sensitivity to give a meter reading of between 50% and 90%.

Walk away from the transmitter moving the receiver firmly left and right with each pace. Peak response with a reduced response to each side indicates the position of the line. It is possible to walk briskly to trace the line.

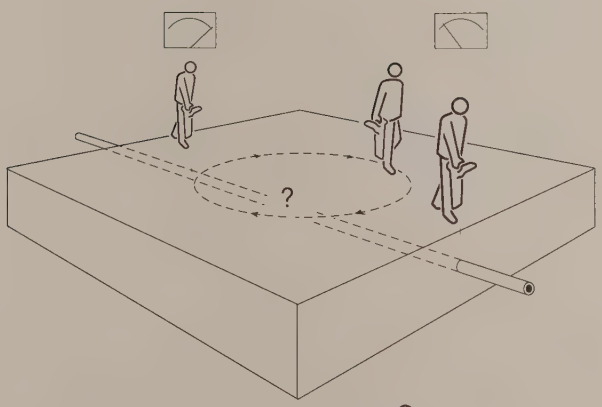
Stop every 10 or 20 paces and carefully check the position of the peak response and then continue walking and tracing.

Check an area several paces either side to be sure that there are no other lines carrying a strong signal.

3.2.5 Tracing with a Precision Locator

Line tracing can be speeded up by switching to the null response. The receiver can be held in any orientation as its null response is not dependent on line direction. Move the receiver left and right while walking along the path of the line to observe the null over the line and peak response to each side of the line.

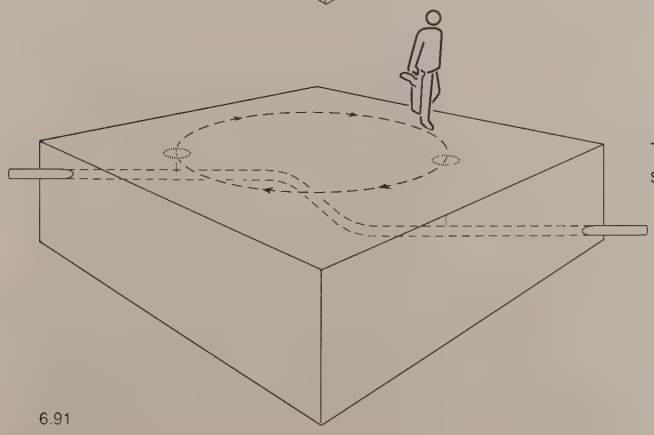
Periodically switch back to peak response to verify the exact position of the target line.



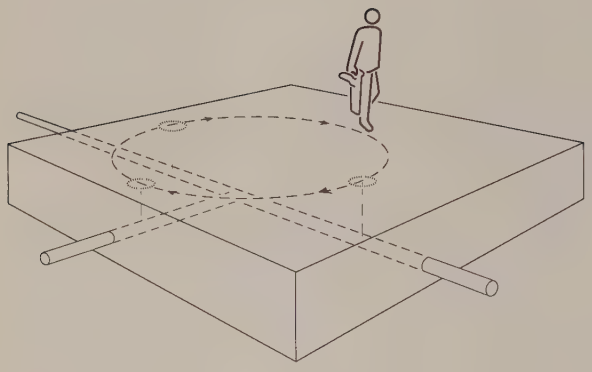
3.2.6 Sharp drop in meter response or other problem

Stop if there is a sharp drop in meter response. Retrace to a position over the line at which meter response is lost. Turn up sensitivity and make an arc about 2 paces radius around the point where the response dropped.

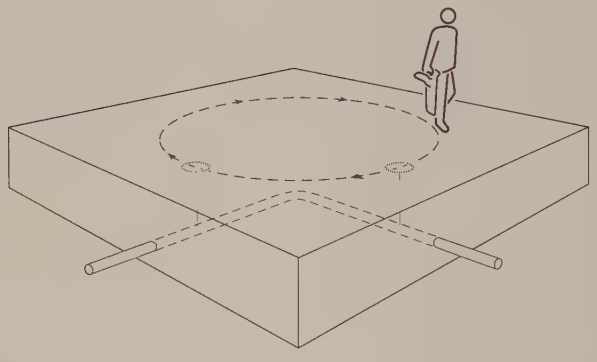
Possible causes:

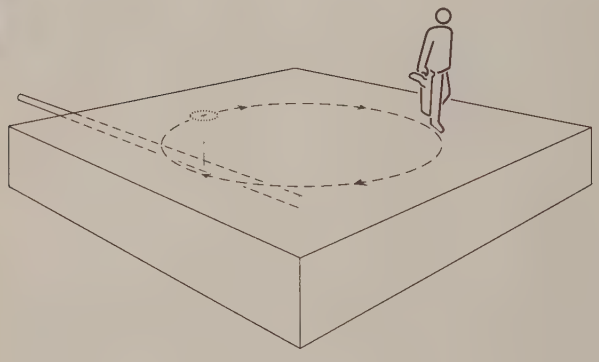


The line may have become deeper. Increase sensitivity to see if it possible to continue tracing.



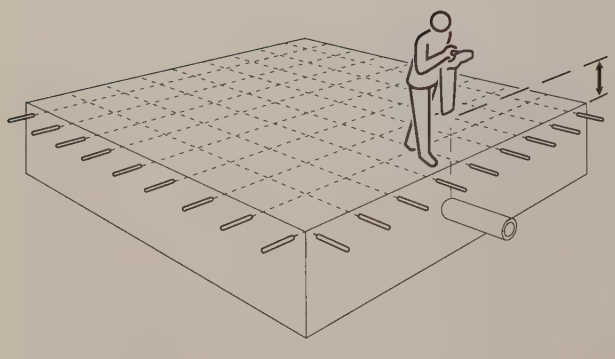
There may be a tee or the line may have altered direction. Check if more than one line with the signal leaves the arc. If there is more than one line measure the response from each line 4 or 5 paces away from the junction. It is probable that the higher response will be the main line, with a lower response on the tee. This is because the signal 'sees' a better ground return from the longer or larger line. It may be advisable to trace both the line and the tee.





Complete loss of signal.
The line may have ended or a metal pipe changed to plastic. The line may run under a metal plate or cover in which case pick up the path of the line on the far side of the cover and continue tracing.

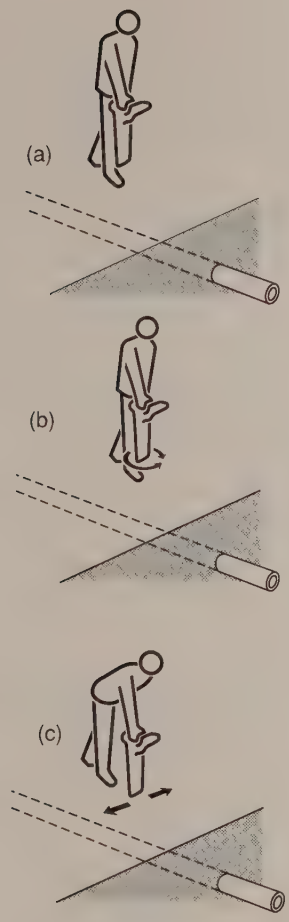
Gradual reduction of response to signal.
Turn up the sensitivity and continue tracing. In time the line may run out of signal. If this is the case bring up the transmitter to apply a signal to the last point at which the line was positively identified.



Signal loses clarity and spreads over a wide area.
The line may be passing under rebars which pick up and re-radiate the signal. Raise the receiver 0.5m/20", reduce sensitivity to the minimum that still gives a response over the signal and continue tracing.

3.2.7 Positive line identification

If it is necessary to verify the identity of a target line after tracing, place the transmitter at the opposite end of the line and trace it back to the original position of the transmitter.



3.3 Pinpointing a target line

Pinpointing defines the exact position and direction of a target line after it has been traced and its position approximately known.

3.3.1 Procedure

Turn the receiver sensitivity to half scale. It will also be necessary to adjust sensitivity throughout pinpointing to keep the meter on scale.

(a) Make traverses from side to side of the line and define the point of maximum response.

(b) Turn the receiver around as if it is a pivot. Stop at the maximum response.

(c) Hold the detection blade near the ground and with the blade vertical. Check blade is vertical by observing bubble level.

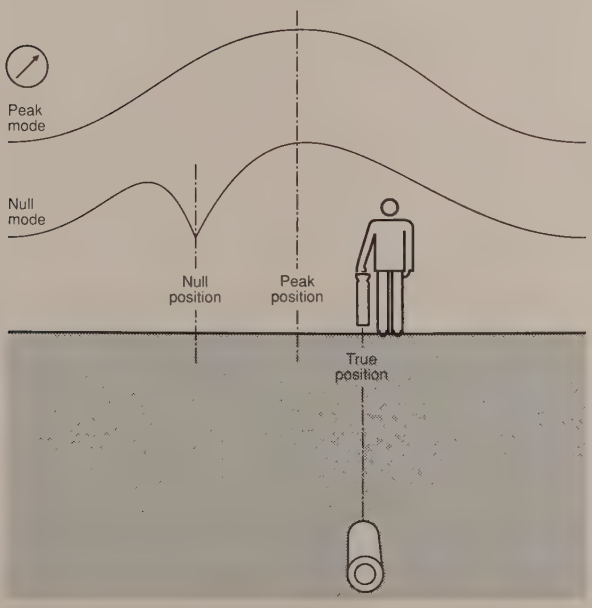
Still with the blade near the ground and vertical, rotate the receiver like a pivot and stop at the position of the peak response.

Still with the blade on or near to the ground move the receiver gently from side to side to define the exact position of the peak response. The detection blade will then be directly over the target line and at right angles to it. Mark the line position.

3.3.2 High resolution pinpointing

Use the loudspeaker tone instead of the meter. The loudpseaker (or headphone output) switches off at lower signal levels. Use this function to get a precise narrow response at the point of the peak signal.

Gradually reduce sensitivity so that the tone-on band gets more and more narrow until the required response width is obtained.



3.3.3 Pinpointing with a Precision Locator

Follow the procedure for pinpointing with a peak response (3.3.1) and mark.

Switch to null response and mark the position of the null response over the target.

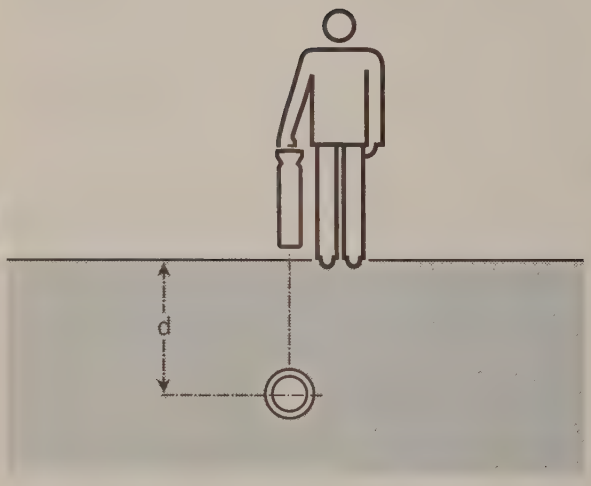
If the position of the mark from the peak and the null pinpoints correspond, it can be assumed that the pinpoint is precise. If the marks do not correspond the pinpoint is not precise. Note that both marks will show an error to the same side. True position will be close to Peak position.

3.3.4 Pinpointing precautions

If two lines are close together, a part of the transmitter signal may have coupled and be present on a nearby line and affect the accuracy of the pinpoint. Check by increasing receiver sensitivity and move the receiver 3 paces to each side of the target line. No response other than from the target line, or a single peak response with symmetrical decay each side, confirms the accuracy of the pinpoint.

If signal is present on another nearby line or if the response decay either side of the peak is asymmetrical, it will be necessary to pinpoint the target further along the line where interference is not present. If this is not possible it is almost certain that the position of the line indicated by the receiver is displaced toward the source of interference and a precise pinpoint is not possible.

Pinpointing over areas with re-bars may give confusing responses. Raise the receiver 0.5m/20" above the surface and repeat pinpoint procedure, making sure the blade is vertical. The meter will respond to the signal from the target line and will not be affected by signals reradiated by the shallow rebars.

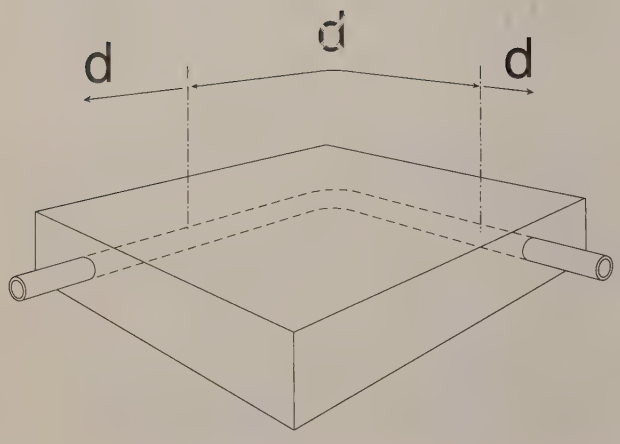


3.4 Depth measurement

Push button depth measurement to a line is possible down to depths of 3m/10ft when the line has been energised with the transmitter signal. Triangulation may be used for greater depths or to check the push button method.

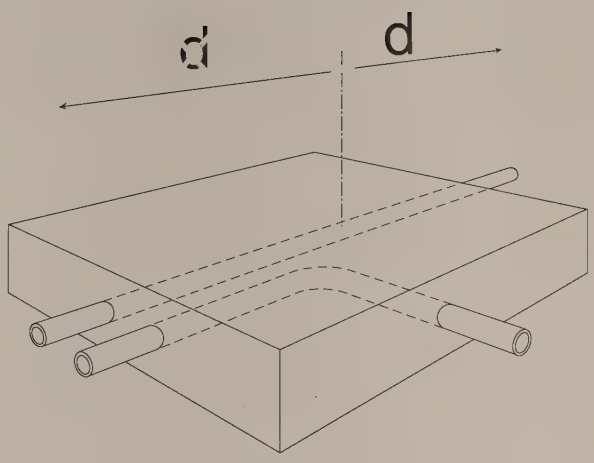
It is not possible to measure depth with the receiver in the Power or Radio modes.

Measurement is to the middle of the pipe or cable. Depth of cover is necessarily less than the reading, possibly critically so on large diameter pipes.

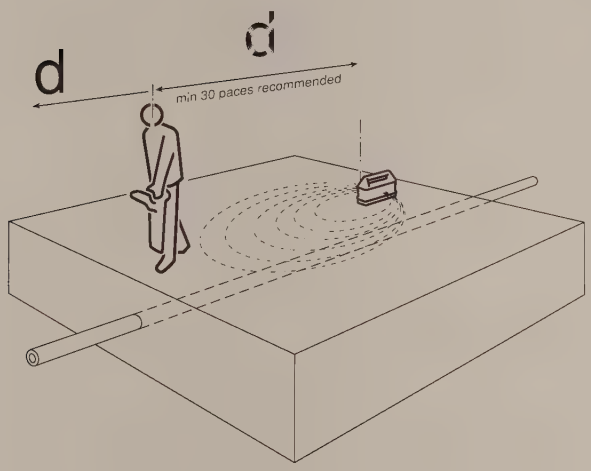


3.4.1 Precautions:

Do not make depth measurements near bends or tees in the line. Go at least 5 paces from a bend for best accuracy.



Depth measurement will not be accurate if there is severe audible interference or if part of the transmitter signal has coupled to a nearby line.



Avoid applying the signal by induction. If there is no choice, the transmitter must be at least 30 paces from the point of any depth measurement.

If the transmitter signal is transferring to nearby lines, apply the signal with a double ended connection to the line.

3.4.2 Procedure for push button depth measurement

Pinpoint the target line accurately with the receiver.

Switch Precision receivers to Peak mode.

If using a Precision locator, first pinpoint using both Peak and Null. There is interference if the two positions do not correspond. Re-apply the transmitter signal to eliminate the unwanted signal and try again. Alternatively, make the depth measurement at a point where the two signals correspond.

Check the receiver is directly over the line, the blade at right angles to it and vertical (check the bubble level). Adjust sensitivity level to bring the meter indication on scale.

If the receiver is fitted with a moving coil meter ensure the meter indication is in the red band. Press the depth pushbutton and keep it depressed. After a few seconds, the meter will indicate depth on the Line scale.

If the receiver is fitted with a liquid crystal display check receiver is in Line mode. Key in Depth. The liquid crystal display will indicate 'dEP' followed by the measurement which will be displayed for a few seconds. Keep depressed for a continuous reading.

If the ground appears to radiate a strong field, perhaps near a radio station, check depth by holding the bottom of the antenna 5cm/2" above the ground and deduct this from indicated depth.

A suspect or critical depth measurement can be checked by lifting the receiver 0.5m/18" above the ground and re-measuring. If the measured depth increases by the same amount it is a good indication that the depth measurement is correct.

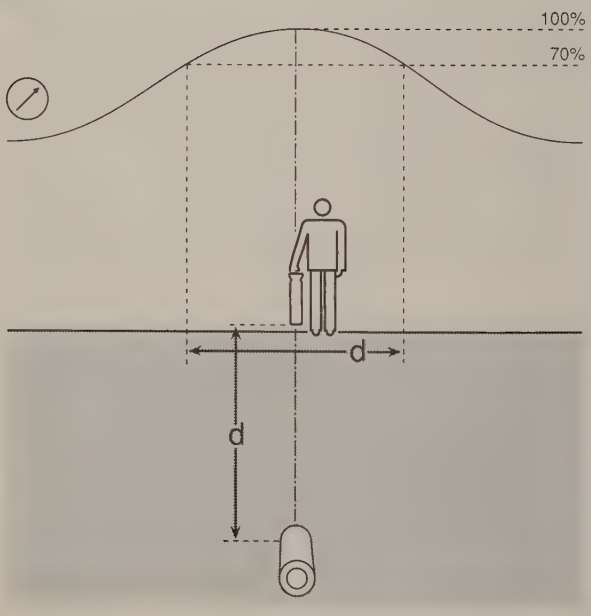
Depth measurement should be accurate to 5% if the conditions are suitable. However, the user may not always know if the conditions are suitable so the following techniques should be used to check critical readings:

Check that the line's route is straight for at least five paces to either side of the measurement point.

Check that the signal is reasonably constant over the ten paces length and make depth measurements to either side of the original point.

Check that there are no adjacent lines carrying a significant signal within three or four paces of the target line. This is the most common and most serious source of error of depth measurements; a strong signal on a adjacent line can often introduce +/-50% error.

Make several measurements at points slightly displaced from the line's apparent position. The most shallow indication will be the most accurate and will also indicate the line's position most accurately.



3.4.3 Procedure for using triangulation to measure depth

If there is any doubt about a pushbutton depth measurement, it should be checked by triangulation. This involves measuring the signal at different points and is an effective check because it is unlikely that a signal will suffer the same error distortion in each direction.

Set the meter to 100% when directly above the line; with receiver vertical and tip close to the ground, move to both left and right until the meter drops to 70%. Mark these points and measure the distance between them.

The distance between the two points is equal to the depth and the two points should be symmetrical either side of the position of the line. Do not use this technique for depths less than 20cm/8in.

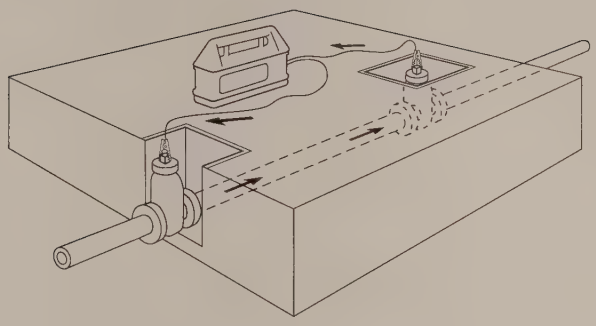
Accuracy of depth measurement is assured if all techniques give similar depth measurements.

Do not attempt to measure depth with 45 degree technique advocated for other types of locator; it is often prone to erroneous readings due to signal distortions.

3.5 Additional techniques

for applying the transmitter signal to a target line

There are a number of techniques for applying the transmitter signal to a target line in addition to those described in Section 3.1. Although these techniques may not be needed for general use, they can often be useful for applying a signal successfully to a target line in particular circumstances.

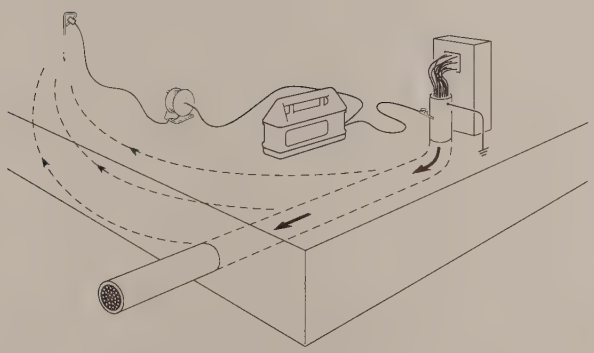


3.5.1 Double ended connection

A useful technique for positively tracing and identifying a target line in a situation where there are access points at each end of the line.

Procedure
Connect the transmitter to an access point on the target line. The transmitter ground socket is connected via a cable or the cable reel to another access point on the line. A complete circuit is achieved without using ground as a current return path. The long cable should be kept as far away as possible from the expected route of the line.

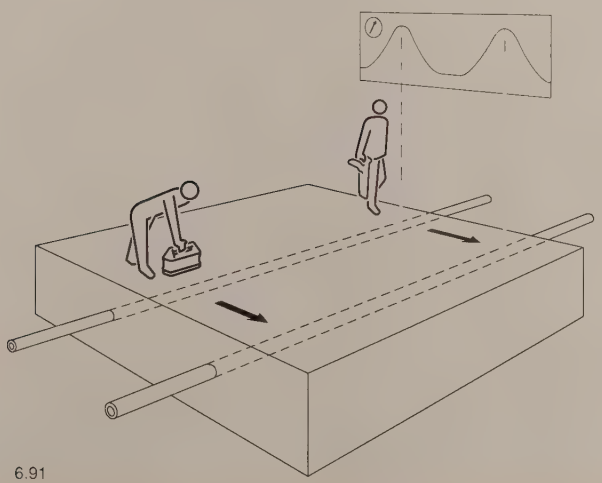
This method of applying the transmitter signal is ideal for positive identification of a target line. When a connection has been made to two points on the same line, the same level of current should be detectable all round the circuit. The receiver meter reading should therefore be constant if the depth of the line does not change.



3.5.2 Single ended connection with remote ground

A technique suitable for drawing a signal along a 'reluctant' target line or for making a signal travel a longer distance along a target line.

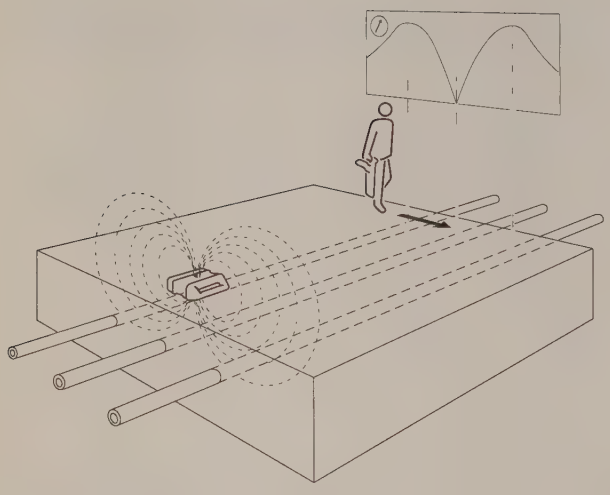
Use an extension cable to place the grounding point at up to 200 paces from the transmitter and preferably at right angles to the route of the target line.



3.5.3 Induction sweep

A technique to be used when it is necessary to find lines that have no direct access.

Procedure
Two operators are required. One holds the transmitter and inches it very slowly over the lines at least twenty paces from the locating area. The second operator moves the receiver backwards across the area picking up the signal from each line as it is energized in turn by the transmitter. Each time a fresh line has been detected, the transmitter is set down while the line is pinpointed and marked.



3.5.4 Induction null pinpoint

When a target has been found by induction it is worth using this technique to check for the presence of other lines if the area is congested. Using the transmitter on its side, it is possible to position it so that it induces zero signal onto a particular line and energises only other nearby lines.

Procedure
Find the exact position where the transmitter induces the strongest signal onto the line as in Section 3.5.3.

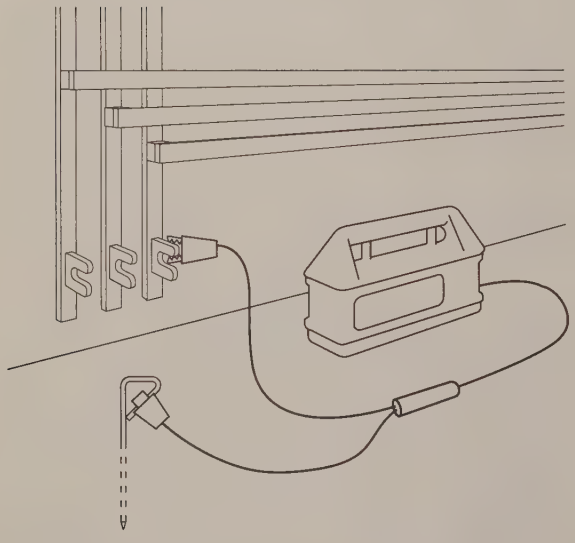
Hold the receiver exactly over and at right angles to the line.

Lay the transmitter on its side and edge it slowly across the presumed route of the line.

The signal detected by the receiver should gradually decrease until the transmitter is exactly over the line, when the receiver response will be a minimum.

When this point has been established the transmitter is inducing signals onto all lines in the vicinity except the one previously found and directly beneath it.

Search again moving the receiver to left and right to detect any other lines. Repeat the procedure until the area with congested lines has been searched with the transmitter in as many positions as necessary in the area.



3.5.5 Applying the transmitter signal with the live cable connector

Only for use up to 500V.

The live cable connector is an optional accessory to apply the transmitter signal to a live cable. It is for use only by personnel licensed or permitted to work on live cables.

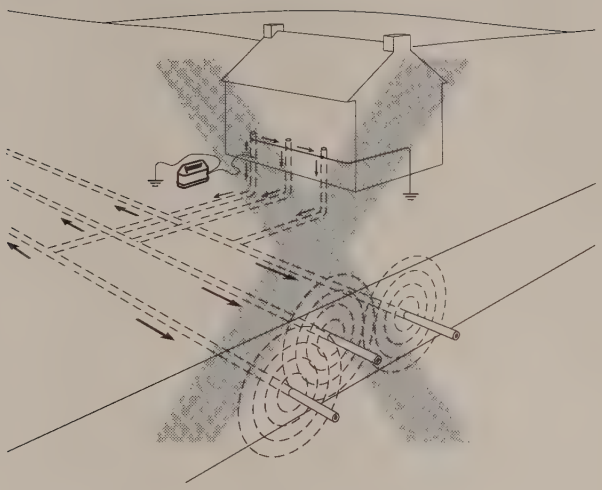
Procedure
The live cable connector is plugged into the transmitter. The red clip is connected to the live conductor and the black clip connected to neutral or ground as appropriate. The transmitter changes tone when a satisfactory connection has been made.

Positive cable tracing and identification in a domestic house: connect red clip to terminal box connection. Remove fuse if necessary. Connect black clip to an independent ground stake outside.

Street light cable tracing: connect red clip to incoming live cable. Connect black clip to lighting column if metal or to an independent ground stake.

The live cable connector can be used in a similar way to apply a signal directly to cables through live LV isolators, fuse boxes etc in industrial sites.

The transmitter and the user are protected against voltages of 500V AC RMS up to 60Hz.



3.5.6 Unwanted signal coupling

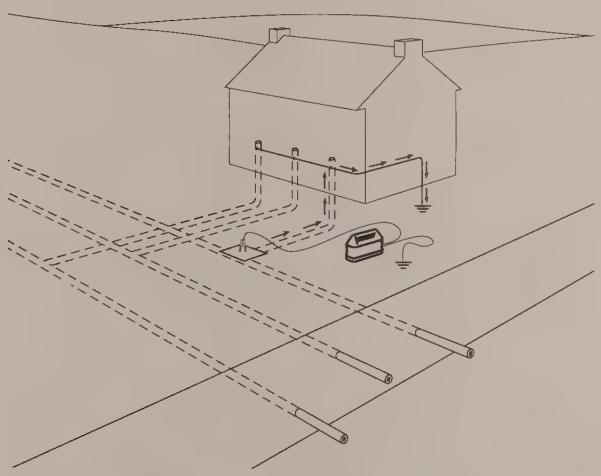
Unwanted coupling of an active tracing signal to another, usually adjacent, line is one of the commonest location problems. It leads either to an error in the marked position and depth of the target line or to marking the wrong line. A certain degree of coupling is unavoidable in many situations but there are ways in which a careful user can reduce coupling and increase location reliability.

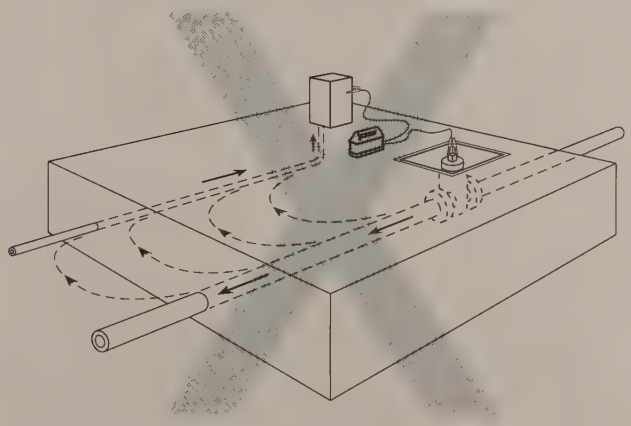
Two situations can cause unwanted signal coupling:

a) Applying the signal to more than one line. Do not use induction. Use the signal clamp where possible.

Identify the points where different lines may be bonded or in close proximity. Work towards these points rather than away from them. For example if gas and water are bonded within a building, and it is required to trace the lines entering the building, apply the signal at the stop-taps or valves in the road rather than in the building.

Reduce coupling to a parallel line by using a low signal frequency where available.





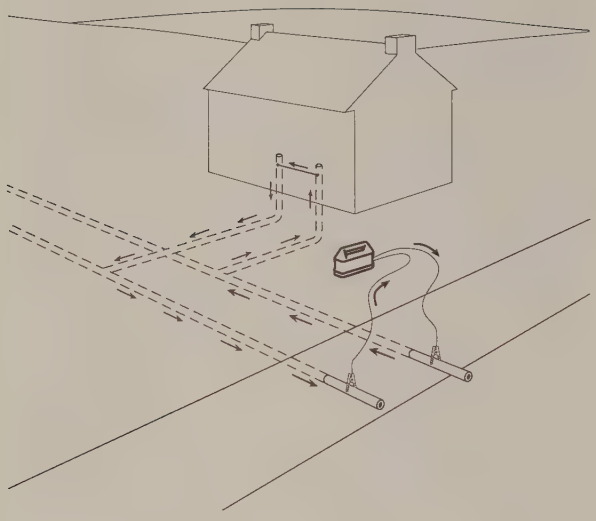
b) Return signal flowing on another line. Use a double-ended connection to by-pass the ground return if possible.

Choose a signal application point where the line is furthest from other lines; not a congested area.

When using single-ended connection, site the ground stake as far from the target line as possible and away from other buried lines.

Avoid using existing structures for ground connections if other buried lines could be bonded to them.

A bad ground or just laying the ground cable on the road surface at right angles to the line may give less coupling than a good ground if long distance tracing is not required.



3.5.7 Applying the transmitter signal for maximum tracing distance

Several factors influence the distance that a line can be traced. The aim of any current flowing on the line is to get off the line and return to the transmitter ground. This results in the familiar gradual decay of the signal strength with increasing distance from the transmitter. It is therefore necessary to apply the strongest possible signal in the most effective manner.

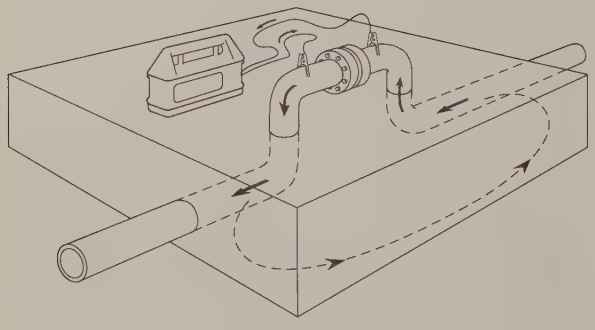
Double ended connection where the transmitter cables are connected to both ends of a line is a very effective way of applying a signal because the ground is effectively bypassed.

The other advantage of double-ended connection is that the signal is being applied to what amounts to a short-circuit so that the transmitter output is at maximum.

Sometimes an effective double-ended connection can be achieved over very long distances by applying the two transmitter clips to two converging lines. For example, if two lines, say water and gas, both follow roughly parallel paths to a distant building where it is known they will have a common bond.

A connection to both lines if effectively double-ended should ensure a strong signal over a great distance. Caution must be taken when tracing to avoid confusing the two lines.

Improving the quality of the ground connection can increase the applied current and therefore the tracing range. The ground can be improved by careful positioning of the ground stake in damp soil, by hammering a long copper pipe into the ground or by connecting to an existing metallic earthed structure.

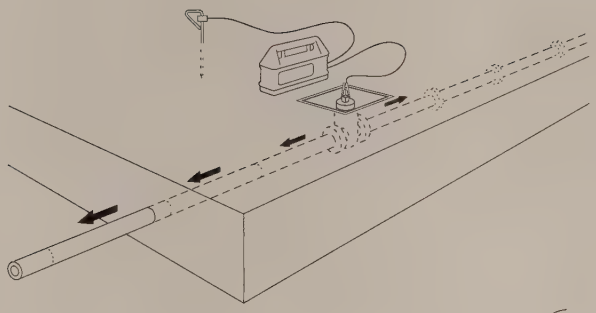


The best possible ground connection in any given situation will be the line itself. The only situation when it can be used is where the line has an insulated section effectively splitting it into two conductors. For example, a long distance pipeline which has an insulating flange; applying the transmitter clips to either side of the joint will apply the best possible signal.

This connection technique is essentially the same situation as when a signal clamp is put around a continuous line and this may often be more efficient than a conventional single-ended connection, provided the signal 'sees' a good quality ground in both directions.

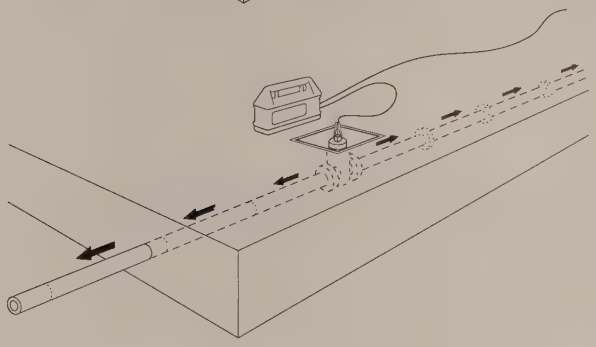
A single-ended connection signal will apply current in both directions of a line if connected to the middle rather than one end. The signal can be doubled if it is possible to disconnect the line in the unwanted direction.

Induction should be avoided. It is an inefficient signal application technique because most of the transmitter energy is wasted in the ground.

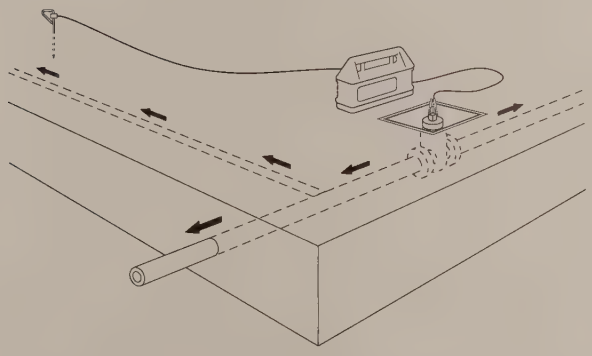


3.5.8 Direct connection: overcoming problems

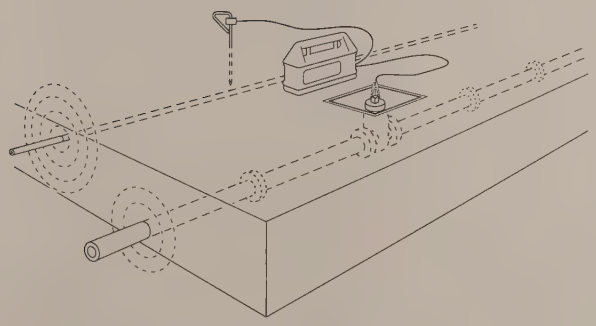
Sometimes when making a single ended connection to a service, the majority of signal travels not along the section to be located, but in the opposite direction. The cause could be the fact that there are mechanical joints on the leg to be located and welded joints in the opposite direction. If the mechanical joints offer some electrical resistance, the signal takes the easiest path which would be along the welded section.



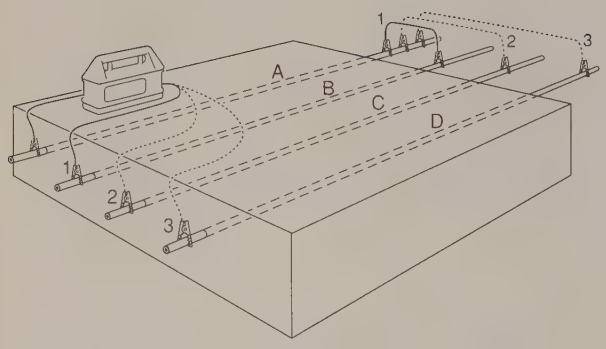
The situation can often be improved by moving the return to a position which encourages the signal to flow in the desired direction. This usually means positioning the ground stake in the general direction of the section to be located. Normally this is achieved using the standard ground return lead, but in a more difficult situation it may be necessary to use the 200m extension reel to position the ground stake in the approximate vicinity of the conductor and as far from the transmitter as possible.



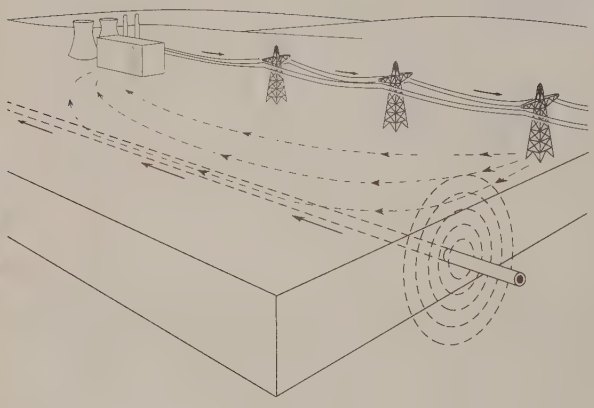
This technique can be used to encourage the signal to take the required path from a tee or junction. Of course, the double ended connection would be used in preference when possible.



Ground return signals when using the single ended connection can often cause confusion by returning to the transmitter along other services. The problem sometimes occurs when return signals appear stronger than on the actual target line usually because the target line is deeper than the conductor carrying the return signal and the return path may be a better electrical conductor than the target.



An adjacent parallel line can be used to an advantage - especially for long distance location. By making one transmitter connection to the target line, the other connection to an adjacent line, and bonding the two lines together at a distant point - effectively a double ended connection - the signal will travel along the target line and back down the adjacent line, giving two definate locations. The use of visual clues plus depth measurements etc., should enable the user to make reasonable identification. Where there are many parallel conductors the task of identification becomes easier because by systematically using other lines as return paths, the location position onto the target line will remain constant. By using a process of elimination the target line can be identified.



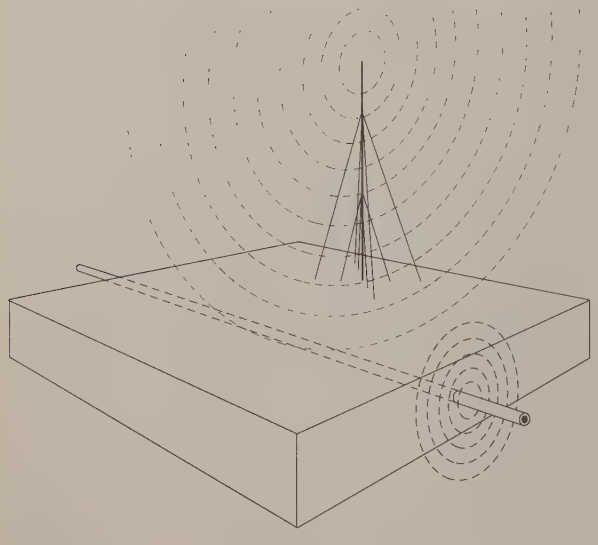
3.6 Searching an area to locate buried lines

There are a number of techniques available for locating unknown lines in an area. Use of these techniques are particularly important before digging in order to avoid damage to buried lines.

3.6.1 Passive modes

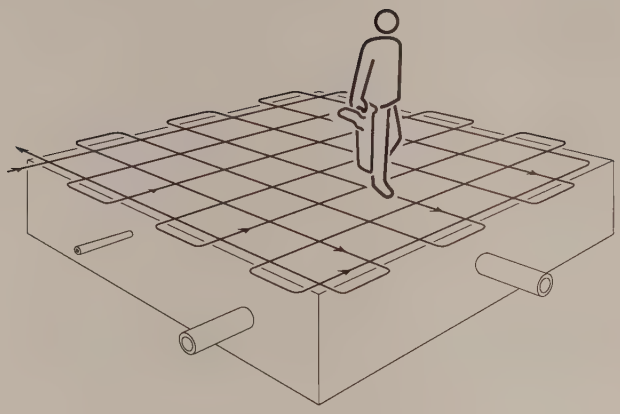
The passive modes, Power and Radio, provide a convenient means of searching for lines. They will not necessarily find all lines but offer a lot of information which helps to sort out complex sites. Always use both Power and Radio, never rely just on Power.

Power mode detects the 50/60Hz energy present on buried cables and other lines.



Radio mode locates buried lines as they reradiate very low frequency radio energy.

Radio signals may not be present in detectable strength in some parts of the country. Where present, the Radio mode is a most useful method to locate buried lines, in particular long distance telephone lines and other lines not radiating a Power signal.



3.6.2 Passive search procedure

Turn function switch to Power+.
Turn sensitivity to give a meter reading of around 50%.

Traverse the area in a grid search, at a steady walk holding the receiver comfortably with the blade in line with the direction of movement and at right angles to any lines that may be crossed.

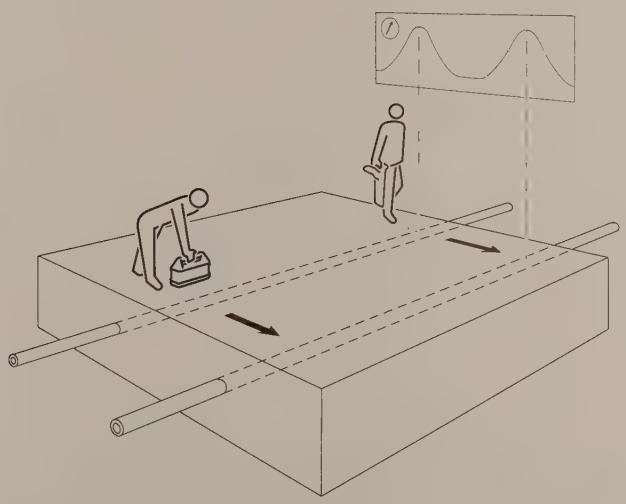
Stop when the receiver response indicates the presence of a line. Pinpoint the line and mark its position.
Mark and trace the line out of the area being searched.
Resume grid search of the area to locate any other lines.

The Power+ search mode is very sensitive (to conform to National Joint Utilities Group UK requirement for locator sensitivity). It may be too sensitive in some areas and it will be necessary to switch to Power and reduce sensitivity.

In some areas there may be a confusing amount of P signals. Lift the receiver 5cm/2ins from the ground and continue search.

Switch the receiver to Radio, increase sensitivity to maximum and repeat the above grid search procedure over the area, tracing and marking any lines that are located.

In most areas the Radio mode will locate lines that do not radiate Power signals and any grid search should be made in both the Power and the Radio modes.



3.6.3 Active search procedure:

The most certain technique for searching for buried lines requires two operators - the induction sweep.

Define the area to be swept and the probable direction of lines crossing the area.

One operator holds the transmitter and the other the receiver. The transmitter induces a signal onto lines as it passes over them and the lines can then be detected with the receiver 20 paces upstream or downstream.

One operator holds the receiver at the start of the area and with the coils at right angles to the probable direction of the buried lines. Set receiver sensitivity level as high as possible without picking up the airborne signal directly from the transmitter.

The second operator is 20 paces or so either upstream or downstream along the probable path of the lines and holds the transmitter with its length aligned with the assumed direction of the buried lines.

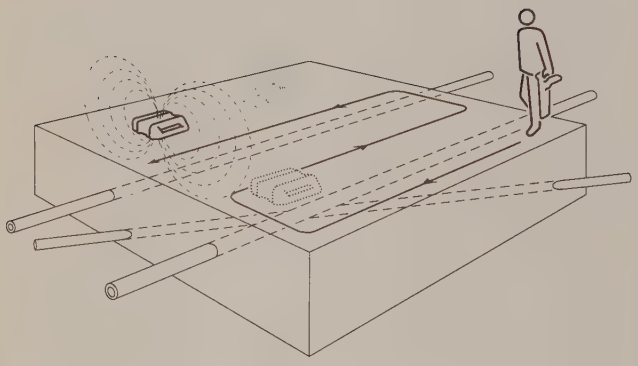
When the transmitter is in line with the receiver, both operators start to move very slowly forward in parallel.The operator with the receiver also moves it backwards and forwards as he proceeds in parallel with the transmitter.

The transmitter applies its signal to lines directly below it which are then located with the receiver.

Mark the ground at the point of each peak signal detected with the receiver.

Repeat the sweep along any other possible paths of lines.

Once the position of the lines has been marked, reverse positions and place the transmitter over the marks and along their axis and trace each of them out of the area being searched with the receiver.



3.6.4 Additional active search procedure:

A technique that is not as thorough as the previous procedure and should only be used if only one operator is available or if there is not sufficient space for the previous search procedure.

Lay the transmitter on its side. The transmitter signal will energise all the lines to either side but not lines running directly below the transmitter.

Sweep with the receiver at least 10 paces from the transmitter. Pinpoint and mark any lines that are located.

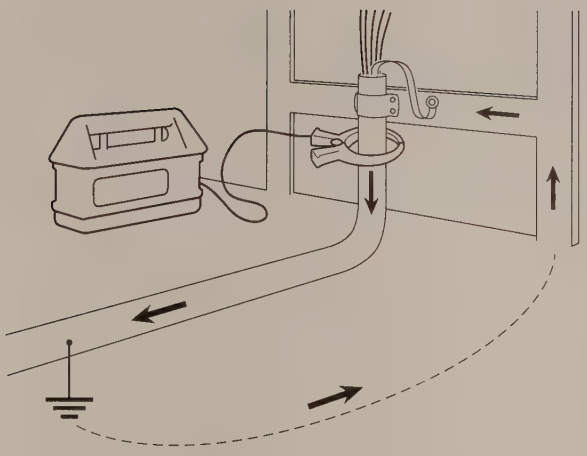
Reposition the transmitter at 5 pace intervals around the site, sweeping each time with the receiver.
Stop when there is a response. Pinpoint the line and mark it. Trace the line out of the area, marking its route.

4 Applications

4.1 Tracing buried cables

Techniques for tracing buried cables are described in Section 3.2. The instructions should be followed and the cable should be pinpointed at intervals to confirm the precise position of the cable that is being traced.

RD400 series locators have been used on a large number of telecommunications systems. No incident of interference resulting from the application of the transmitter signal has been reported.



4.1.1 Tracing a line can only be done positively with the transmitter signal applied to it at some access point.

Inducing to a line is not a positive way of tracing a target line. If there is no alternative, induce a signal and trace the line to a point of access and then connect or clamp a signal to it and trace it back for identity confirmation.

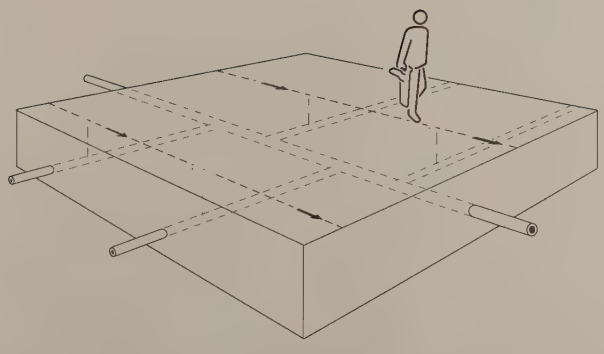
Having applied the signal and confirmed it is flowing, do not assume it is only on the target line. Always take the precaution of walking a circle of about 5 paces around the transmitter and note all signals crossing the circle. The required signal should be the signal giving the strongest response, especially if a signal clamp is used.

4.1.2 Sometimes it is necessary to compare signals on different lines to determine which is carrying the strongest signal or for line identification. Usually it is sufficient to just check signal strength on the meter, but if the lines are at significantly different depths, some compensation should be used. To compare actual signal strength:

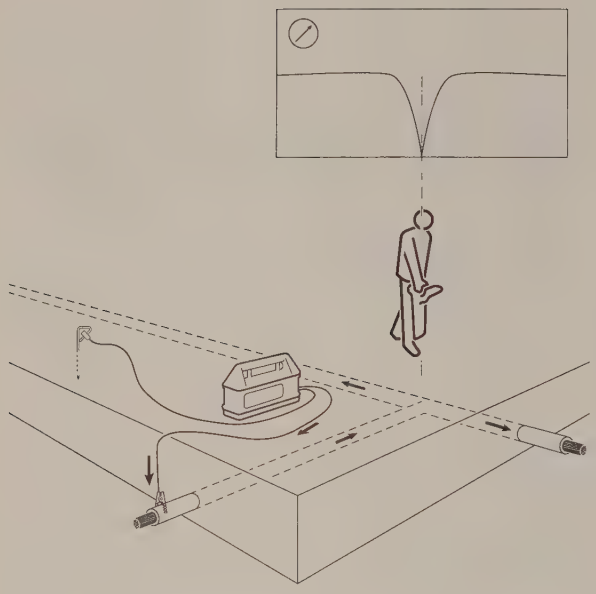
Set receiver sensitivity to give reading of 100% (or maximum round figure obtainable) over line with highest reading.

Maintaining same sensitivity setting, note reading obtained above other lines.

Check depth of each signal source and multiply each signal reading by the corresponding depth. The source giving the maximum product of reading and depth carries the strongest actual signal.



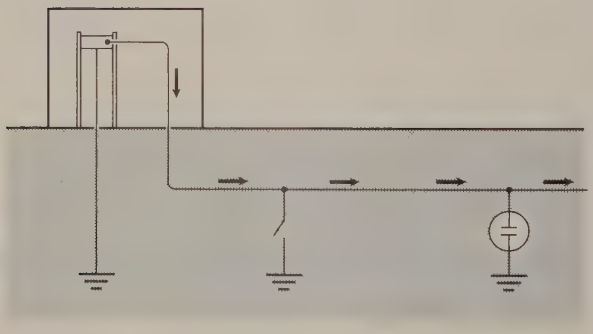
4.1.3 Locating tees. Once the path of a line has been traced and marked, and with the transmitter signal still applied carry the receiver along the line again, about one pace to the side and with the blade parallel to the line. No signal (or very little) will be picked up from the main, but branch connections will show up with clear responses.



4.1.4 The most reliable method of pinpointing a tee is to apply the transmitter signal to the end of the drop or service. The signal will flow to the main and then along in each direction. Tracing the signal back to the main with the blade at right angles to the service will result in a null over the tee.

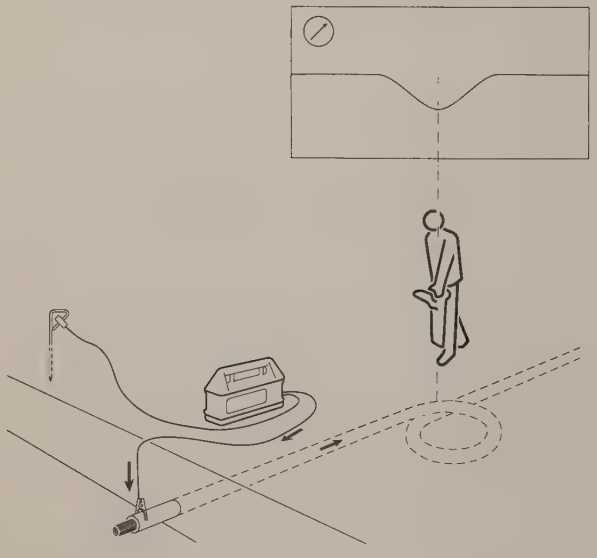
4.1.5 Tracing cables from a splice or joint chamber. It will be necessary to remove the common bond from cables before applying the transmitter signal in order to trace a target cable.

If it is required to trace all the cables from a chamber, the transmitter in induction mode can be placed to one side of the chamber and in line with the cables to be traced.



4.1.6 Tracing long distance cables. It may be necesary to remove ground connections in order to get the transmitter signal to travel a sufficient distance.

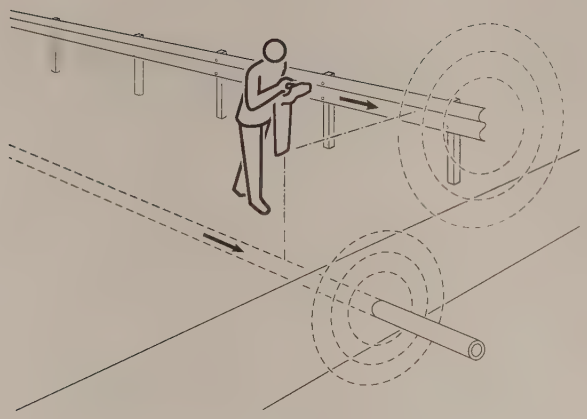
When splices or joints are grounded for reasons of safety or for lightning protection, they can be permanently replaced by surge arresters to allow uninterrupted locating and cable protection.



4.1.7 A slack loop in a buried cable will sometimes cause a fall in response over the path of the cable which should be investigated.

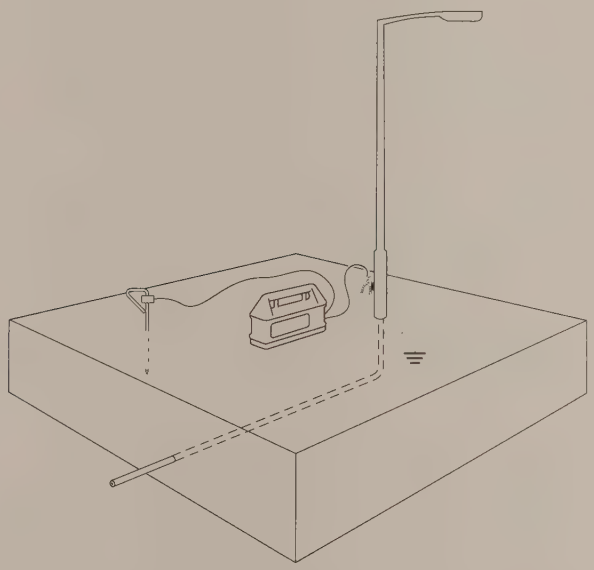
Return to just behind the point of the change in the response and widen the arc of search. The receiver will define all but the smallest loops in the cable.

4.1.8 Splices. Most cable splices or joints will show up as a blip in the receiver response. Local knowledge and experience will help the user know if the blip indicates a splice box.



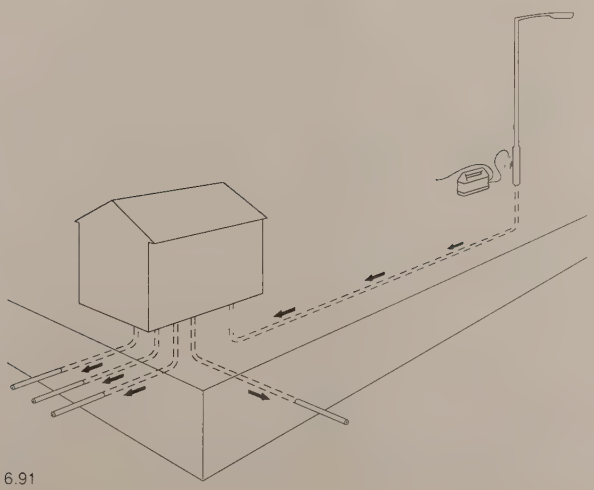
4.1.9 Tracing along a highway. The cable is frequently buried directly at the side of the metal crash barrier and the signal couples to the continuous metal barrier. This makes tracing difficult because of the proximity of the barrier to the lower aerial in the antenna blade.

The problem can be overcome by raising the receiver so that the lower aerial in the bottom of the detection blade is level with the metal barrier.



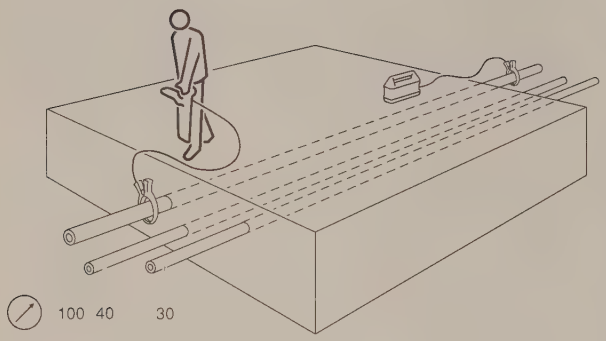
4.1.10 Street lighting. Connecting to a metal street lamp column is almost as effective as connecting to the cable sheath itself. Normally the cable sheath is bonded to the metal column, therefore a simple connection with the magnetic connection clip onto the column enables the operator to locate the street lighting cable quickly and safely without having to call out the lighting department.

Concrete columns - unless the cable is earthed to the inspection door frame, it will be necessary for the lighting department to make the transmitter connection to the cable sheath. The knowledge gained of position and depth of lighting cables (plus feeds to other street furniture on the same system) makes the exercise well worthwhile. One connection point will energise cables over a considerable area.



The use of a street light column as a means of applying a signal to other power cables is a possibility . The signal may be fairly weak when using this method because it may have travelled some distance back to the sub station and out again on the other system, but with the transmitter used on a high sensitivity setting it is often possible to locate a cable which would otherwise have been difficult or inconvenient to energise.

4.1.11 Cables running down a wood or concrete pole or lighting column can be energized by standing the transmitter at right angles to the ground in its induction mode against the pole.



4.2 Cable identification

The locator can be used to assist identifying a target cable at distance access points.

4.2.1 Apply the transmitter signal with the signal clamp. Check if there are bonds between the cable and other cables or services and remove the bonds if necessary.

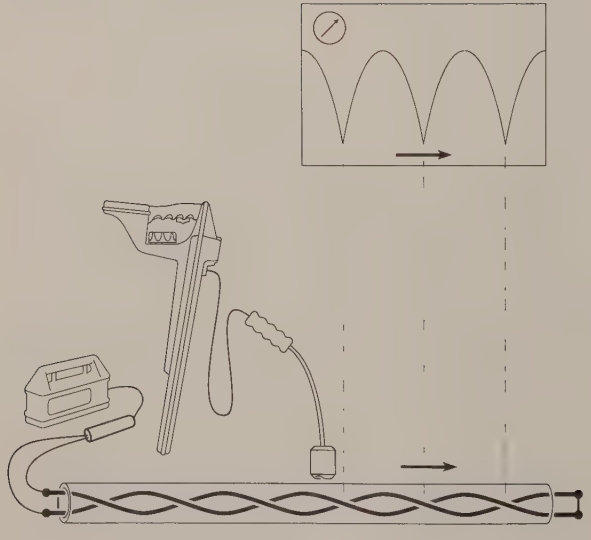
Alternatively qualified personnel can use the live cable connector to apply a very selective transmitter signal to a low voltage cable core.

Trace the cable following the instructions in Section 3.2. Be sure to check that the cable with the strongest signal is being traced. Trace the cable to the access point at which the cable identity has to be established.

Plug the clamp antenna into the receiver accessory socket and clamp round each cable in turn, noting the meter response. Compare the strength of responses from each cable. The cable with a substantially stronger response than the others will be the cable to which the transmitter signal has been applied.

It may not be possible to put the clamp around the cables because of congestion or because of inaccessibility. The large or small stethoscope should be used in the place of the clamp antenna. Press the concave detector head against each cable and note the response from each cable.

To be sure that the cable has been correctly identified, reverse the position of the transmitter and the receiver and repeat the identification routine.



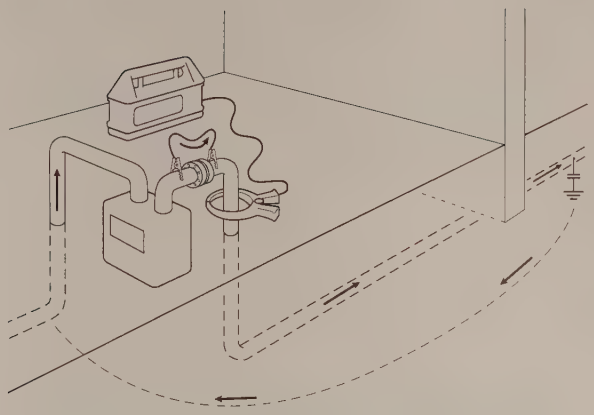
4.2.2 An alternative and superior method of identification uses the effect of cable twist to provide a precise "signature". This method should only be used by personnel licenced to work on live cables.

This technique cannot be used on live cables since it is necessary to arrange a short circuit at the far end.

Always use the Live Cable Connector to energize power cables, even when they are *supposed* to be isolated.

The twisted cores cause a "corkscrew" signal. A stethoscope antenna (not clamp antenna - it cannot detect this corkscrew signal) moved along the cable displays a distinctive rise-and-fall signal.

Other adjacent cables will not show the same effect and this is a positive method of cable identification.



4.3 Tracing metal gas pipes

The RD400 can be used to trace steel pipes and most pipes made of cast or ductile lengths of iron pipe with insulated bell joints between each pipe length.

4.3.1 Where possible trace the pipe from the consumer and into the main.

Clamp the transmitter signal at the meter. Make sure any insulating gasket is bypassed with a jumper wire so that the gas pipe into the house provides an effective ground return.

4.3.2 If the pipe has to be located under or beside the highway make a single ended transmitter connection to a valve with the ground cable connected to the metal frame of the valve box.

Check that the clip is making good electrical connection. It may be necessary to brush off paint or scale before making a connection.

4.3.3 Some gas distribution systems have very few access points or access points cannot be found; perhaps buried under a layer of black top. Determine the approximate position of the distribution main from any existing plan or from local knowhow and induce a signal to it with the transmitter over and in line with the supposed position of the pipe. Trace the signal to a point where the line can be identified at a valve or other access point and then connect or clamp the transmitter signal to the valve.

4.3.4 If a continous steel pipe is being traced use the technique described in Section 3.1 and 3.2

There may be insulating joints along the length of the line and the transmitter signal will have to be re-applied on the far side of each joint. Where possible use high frequency for tracing iron pipes.

4.3.5 Some iron pipes can be traced with the same technique as a steel pipe; the signal easily passes the joints from one pipe to the next.

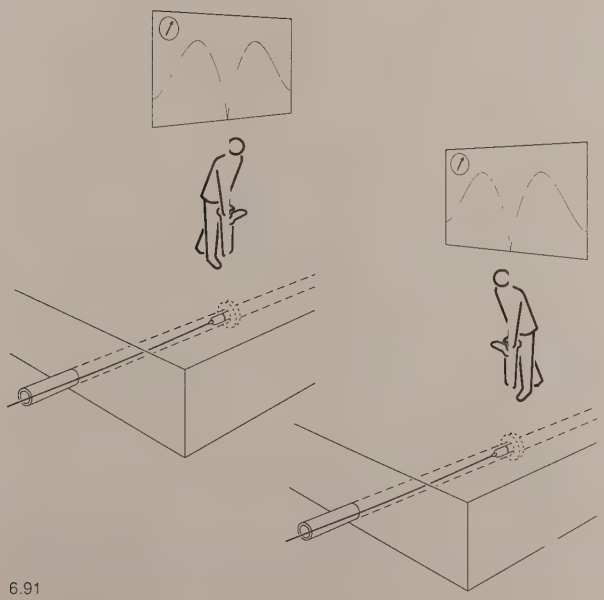
Other pipes may have joints that allow flow of little or no signal. Check if there is any Power signal on the pipe. Check if there is any Radio signal on the pipe.

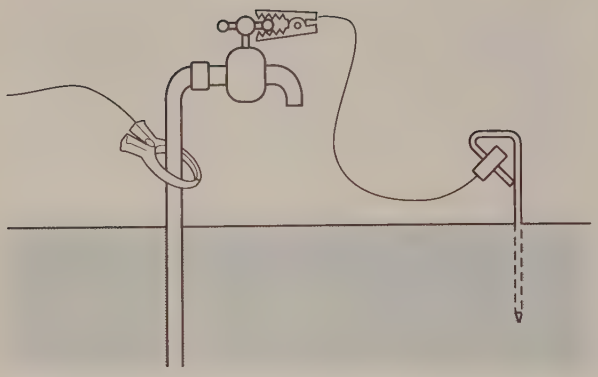
Trace the pipe with an induced transmitter signal and move the transmitter up to the last point where the signal was detected.

It is possible that a combination of two or all three of the above techniques will succeed in tracing the iron pipe.

4.3.6 If a metal pipeline has mechanical joints, all of which are insulated, it may not be possible to locate it by conventional means. An alternative is to use an extension of the method for pinpointing pipe joints. By introducing a sonde into the line, the joints can be located in the usual way, then by turning the receiver 90 degrees to the line, the pipe can be accurately located by finding a null point across each joint position.

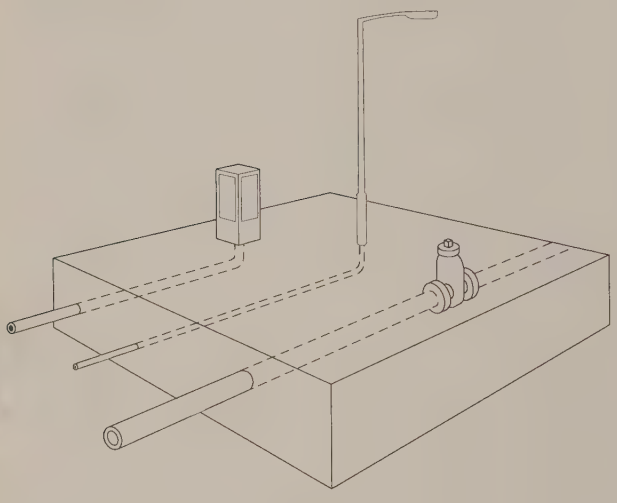
4.3.7 Tees can usually be located with the technique described in Section 4.1.3.





4.4 Tracing metal water pipes

The techniques of tracing gas pipes also apply to water pipes. Water pipes are usually easier to locate and trace because direct access is possible at the stop valves which control supply to each property.



4.5 Surveying a site for buried pipes and cables

The RD400 can be used to locate the position of all buried metal pipes and cables in an area so that the design of a new construction project can be achieved with knowledge of the presence and position of lines.

4.5.1 Preparations

In every case it is always helpful to obtain drawings and as much information as possible about any buried pipes, cables and drains on site. Precise information is desirable but even if the information is not reliable or accurate it will generally tell what lines to expect.

The site should be considered before using the locator; it should be examined for covers, street lights and all other signs indicating the presence of buried pipes or cables.

Define the area to be swept and include a generous margin around it.

4.5.2 Passive grid sweep. Make a grid sweep across the site in the Power+ mode. Hold the receiver with the detection blade at right angles to lines that will be crossed. Select Power if the meter is off scale in the Power+ mode at minimum sensitivity. Repeat the grid sweep in the Radio mode.

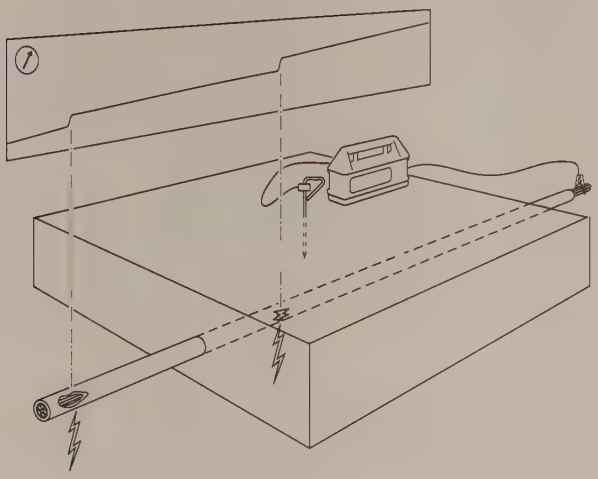
Mark the position of the line at each response then trace and mark the line out of the area.

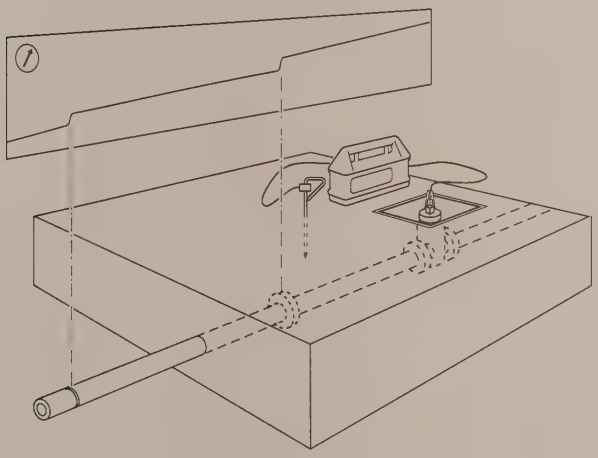
4.5.3 Apply the transmitter signal at any access point to a buried pipe or cable such as a chamber, valve, street light or pedestal. Trace and mark the line out of the area.

4.5.4 Active grid search. An active grid search will detect the line isolated in the passive sweep and other lines not radiating passive signals.

Place the transmitter at suitable intervals across the area and make a grid search with the receiver.

If the lines need to be identified trace them to a point where they surface, such as a cover, street light, fire hydrant etc., then apply the transmitter signal and trace back to the area.

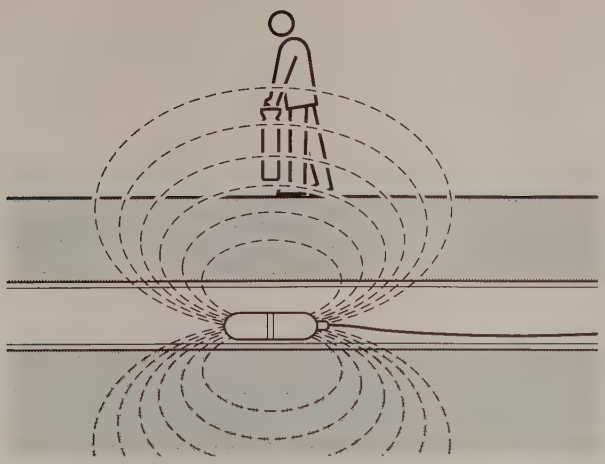




4.6 Locating Anomalies on lines

Some cable ground faults, pipe coating faults and even a circumferential crack in a cast iron pumping main can be detected with the locator.

Apply the transmitter signal to the target line and trace the length of the line with the receiver (precision locators switched to Peak), having set the sensitivity to give a response near maximum over the line. Do not adjust the sensitivity control and note the position of any sharp fall in response.



5 Using a transmitting sonde

A transmitting sonde is a small waterproof self-contained transmitter radiating a signal that is located by the receiver.

The sonde can only be located in a non metallic drain, sewer, pipe or duct. Metal pipe or covers shield the signal and prevent it being detected.

A range of sondes is available ranging from a 13mm/0.5in diameter unit with a range of 1.5/5ft to a unit detectable down to 18m/60ft and are fully described in Section C.

In addition to tracing non metallic pipes and ducts, sondes can be used to pinpoint joints in iron gas pipes, locate leaks in plastic water pipes and monitor the progress of horizontal boring tools and other No-Dig techniques.

5.1 Choosing a suitable sonde

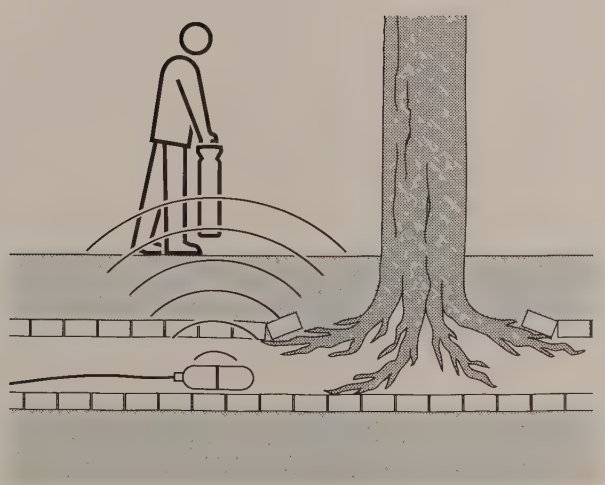
Check that the sonde has sufficient range for the application and is dimensionally small enough and sufficiently robust for the application.

All sondes are vibrated on a three dimensional shock and shake rig to check individual reliability before shipment.

Sewer Sondes and Super Sondes are specially designed for tracing drains and sewers. These sondes have a heavy wall thickness to give a long working life in the sewer environment of shock and abrasive surfaces.

Check that the frequency of the sonde corresponds with the receiver frequency. The receiver will not locate the sonde unless the frequency is the same. Sondes are marked with their transmitting frequency.

Ensure that the means for propelling the sonde are available together with the correct fittings or couplings.

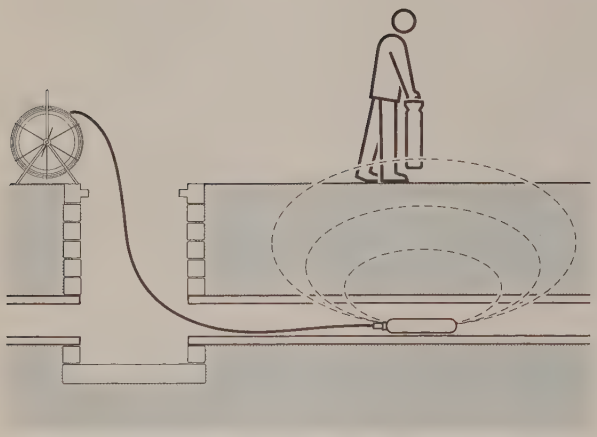


5.2 Propelling the sonde

Sondes have a male M10 thread at one end for connecting to drain rods, the Radiodetection FlexRod or to other devices for inserting and propelling the sonde along a drain or duct.

It is advisable to fit the spring coupling between a rod and the sonde to enable it to negotiate tight corners without damage.

Sondes may be floated along drains at the end of a tether and floats are available for fitting to the sewer sonde and super sonde. Sondes can be strapped to high pressure water jets or similar devices used for cleaning, maintaining or inspecting drains.



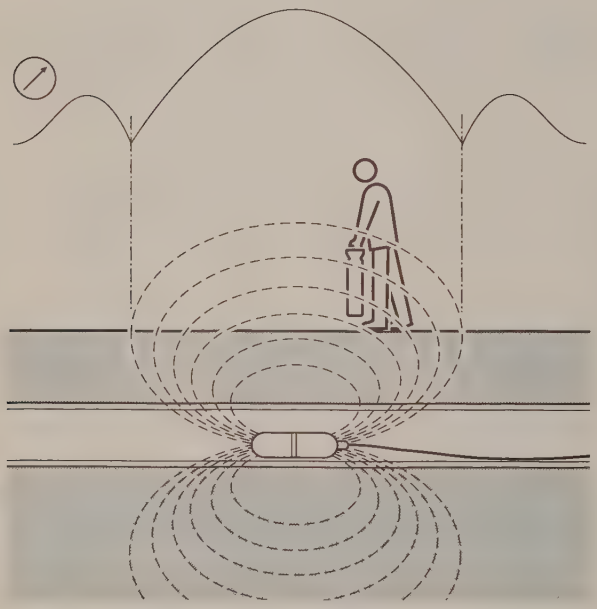
5.3 Procedure for locating the sonde

5.3.1 Insert a new battery in the sonde. A new battery or a freshly recharged battery should be used at the beginning of each day and preferably at the start of each new job.

5.3.2 Check that the sonde and receiver are the same frequency and working correctly. Position the sonde at a distance equal to its rated depth range from the receiver. Point the receiver at the sonde with the blade in line with the sonde (note that this is opposite of using the receiver to locate a line) and check that the meter reading exceeds 50% at maximum sensitivity.

5.3.3 Insert the sonde in the drain access point and locate it while it is still in view.

Hold the receiver vertical directly over the sonde with the blade in line with the sonde. Adjust the receiver sensitivity so the meter reads between 60% and 80%.

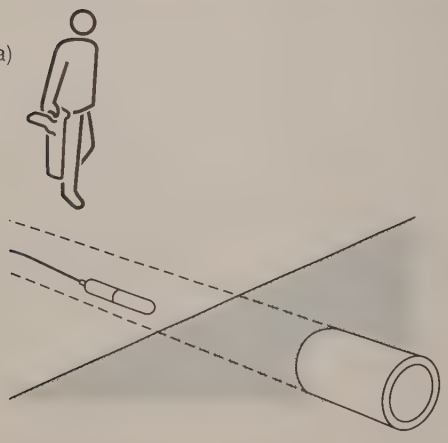


5.3.4 The sonde radiates a peak field from the centre of its axis with a ghost signal at each end of the peak.

Move the receiver a little way to one side and then to the side along the axis of the sonde to detect the ghost signals.

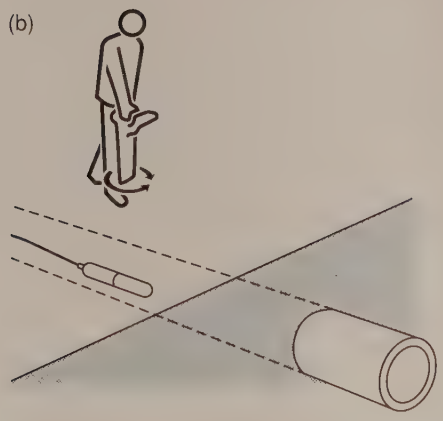
It is a good idea to deliberatley look for the ghost signals. Finding the two ghost signals positively confirms the locate. If ghost signals are present, reduce the receiver sensitivity to lose the ghost signals but still indicate a clear peak response directly over the sonde.

(a)



5.3.5 Do not adjust the receiver sensitivity. Propel the sonde three paces along the drain or duct and stop. Place the receiver over the supposed position of the sonde and

(a) move the receiver backwards and forwards with the blade in line with sonde and stop when the meter indicates a peak.

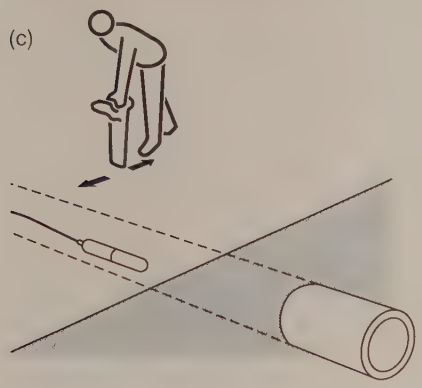


(b) rotate the receiver as if the blade is a pivot. Stop when the meter indicates a peak.

(c) move the receiver from side to side until the meter indicates a peak.

(d) repeat (a), (b) and (c) procedure with the blade vertical (check bubble level) and resting on or just above the ground. The receiver should then be directly above the sonde with the blade in line with the sonde; mark the position of the sonde and its direction.

Check that the real peak rather than a ghost signal has been pinpointed.



Note that the sonde gives a peak response when the receiver is in line with it: the opposite of locating a line.

Propel the sonde a further three or four paces along the drain and pinpoint and mark. Repeat this pinpoint procedure at similar intervals along the line of the drain or duct.

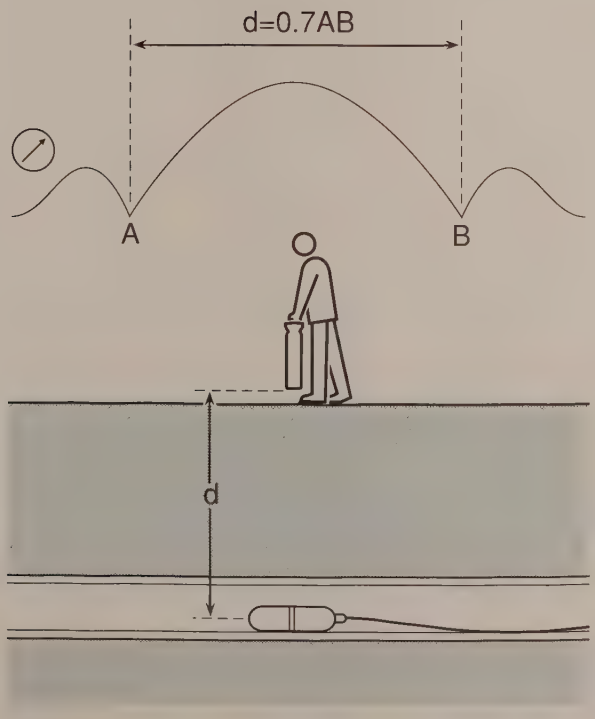
It should not be necessary to increase receiver sensitivity while tracing the sonde unless the depth or the distance between the sonde and the receiver has increased.

5.4 Measuring depth to a sonde

The receiver meter is calibrated to measure depth down to 8m/26ft. Greater depths can be calculated and the calculation procedure can also be used to confirm the accuracy of the meter reading.

5.4.1 Meter depth reading

Pinpoint the sonde following procedure (a) thru (d) detailed in Section 5.3.5. Rest the blade vertically (check bubble level) on the ground and in line with the sonde. Adjust sensitivity level to bring meter indication on scale.



If the receiver is fitted with a moving coil meter ensure the meter indication is in the red band. Press the depth pushbutton and keep it depressed. After a few seconds the meter will indicate depth on the Sonde scale.

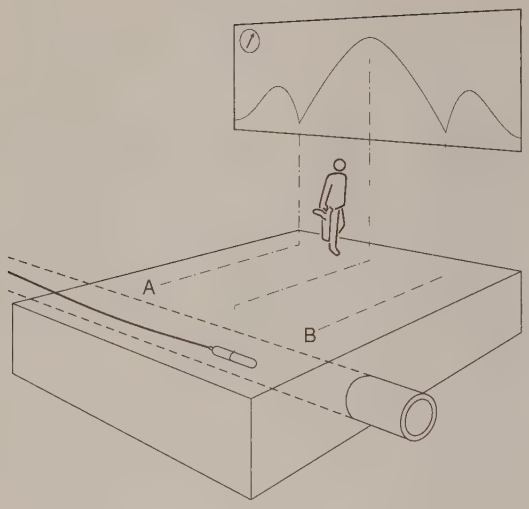
If the receiver is fitted with a liquid crystal display, check receiver is in the Sonde mode. Key in Depth. The liquid crystal display will indicate 'dEP' followed by the measurement which will be displayed for a few seconds. Keep depressed for a continuous reading.

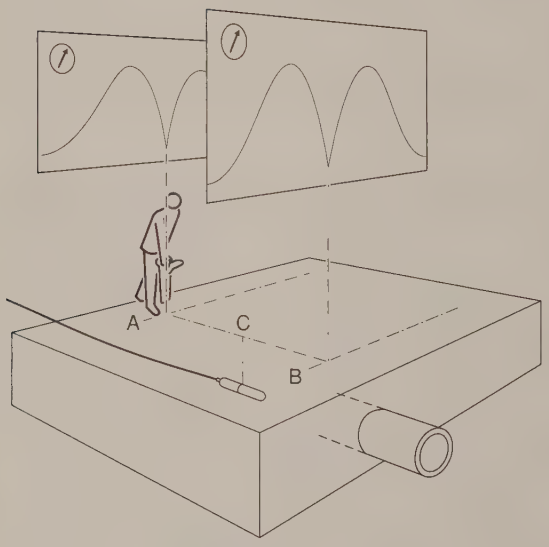
Remember that the reading is to the sonde and not the drain or duct. Depth of cover is necessarily less than the reading.

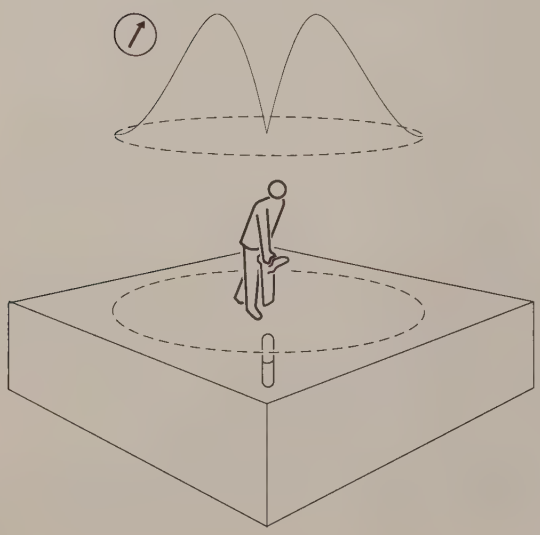
5.4.2 The calculation method to measure depth of the sonde.

Pinpoint the sonde. Move the receiver in front of the sonde and still in line with it, increasing sensitivity to find the peak of the ghost signal.

Move the receiver to behind the sonde always with the blade in line with the sonde. Then find the null positions A and B. Measure the distance between them and multiply by 0.7 to give an approximate depth measurement.







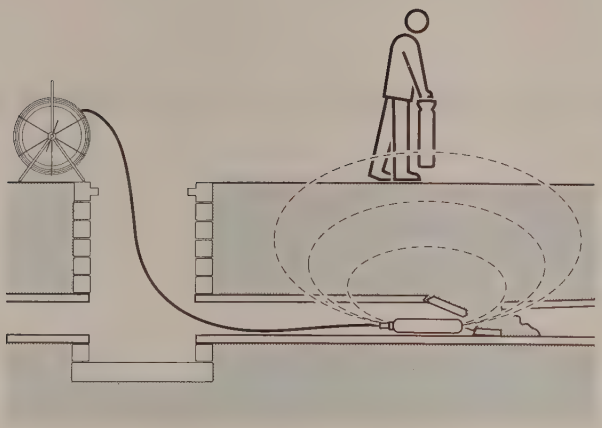
5.4.3 Special techniques for deep sondes

The side to side part of locating a sonde - especially at greater depth - requires a clear area to move the receiver. Sometimes when the location is to be made parallel to the side of a steep hill, or close to a building wall, the side to side movement is restricted. This difficulty can be overcome by using the null points between the sonde main and ghost signal peaks. With the locator blade at right angles to the sonde at these null points, another null can be found and by projecting a line through these points, the sonde can be pinpointed accurately. Accurate depth measurement depends on good sonde location.

As the axial position of a sonde is easier to find than its lateral position, - when more accuracy is required at greater depths - it may be possible to position the sonde across the sewer as well as in line.

This technique is generally used in walk thro' sewers or culverts. First, the sonde is located in its lengthways position, then turned 90 degress and location across the sewer line.

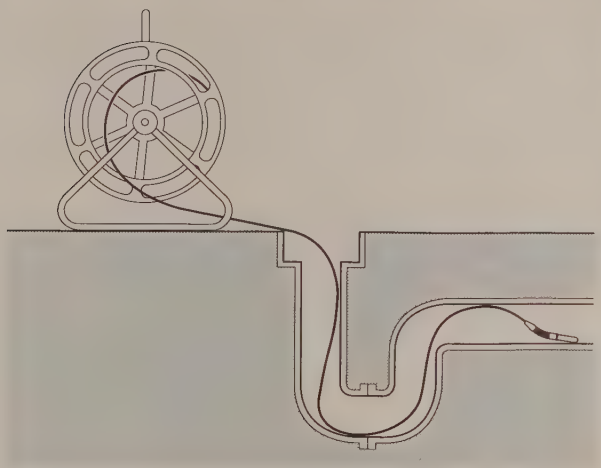
Another method is to position the sonde vertically. The locator on the surface will pick up a pool of signal with a null point in the centre. This is a very accurate method, but depends on the sonde being absolutely vertical.



5.5 Pinpoint a drain blockage or collapse

Propel the sonde with rods, the flexrod or other means along the drain, making locates every 3 or 4 paces.

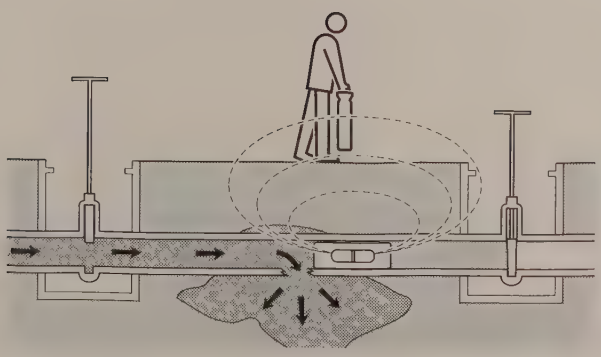
The sonde will come to rest against the blockage. Pinpoint and mark the position.



5.6 Tracing small diameter drains or plastic pipes

The FlexiSonde is a very flexible rod with a Small Sonde built into the end.

Feed the FlexiSonde into the drain or pipe and locate every few paces.



5.7 Locating water leaks in plastic pipes

This is a laborious method to locate leaks and is for use when traditional acoustic systems fail.

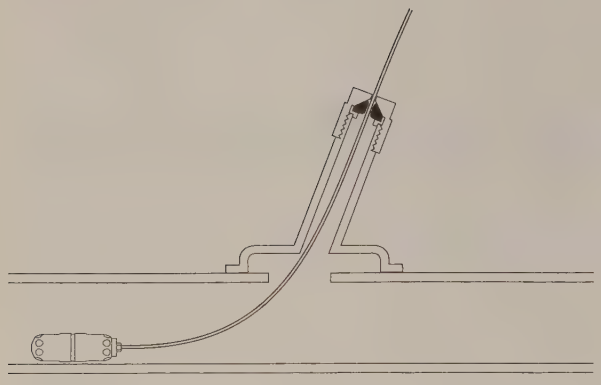
Procedure
Select a suitable sonde and wrap it round with plastic foam to give a tight intererence fit in the pipe. First, isolate the length of pipe by closing valves upstream and downstream of the leaking section. Cut into the pipe and insert the foam swab which becomes a piston in the pipe.

Close the downstream valve and open the upstream valve. The detectable piston will move along the pipe and stop at the point of the leak. It may be necessary to crack open the downstream valve to get the piston on the move.

Correct setting of the valves is made easier if a flow meter is inserted close to the upstream valve.

Calculate the flow rate required to achieve a comfortable speed for the sonde and adjust the valve as necessary. The flow rate should increase when the sonde and piston pass and stop at the leak. This provides a means for determining that the swab has stopped because of the leak and is not just jammed at an obstruction.

It may be possible to insert the Small Sonde in a swab into the pipe by pumping it down a fire hydrant or by removing a valve bonnet.

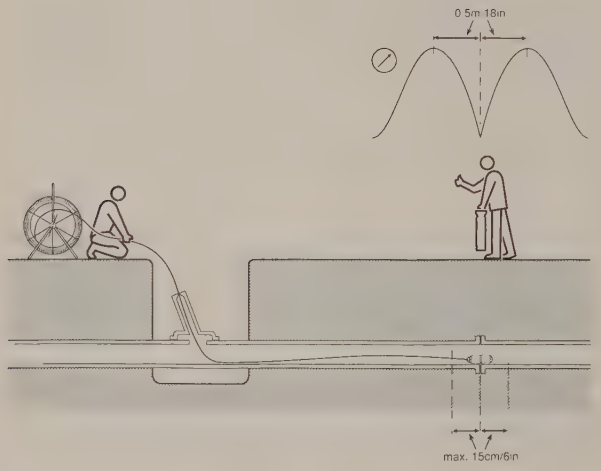


5.8 Pinpointing iron gas pipe joints

If a sonde is inserted into an iron gas pipe the signal is shielded until it reaches a joint or other anomaly when it gives a peak signal to each side of the joint and a null precisely over the joint. This procedure is suitable for locating joints for injecting anaerobic sealant from the surface.

Procedure:
Use the locator to trace and mark the position of the pipe. Mark lengths of 1m/yard along the path of the pipe.

Attach a Standard Sonde to the end of the Flexrod and feed it into the pipe through a special gland. Radiodetection can supply a complete insertion canopy to fit a Wask under pressure drill set or an insertion tube and gland for fitting to other type canopies.



Precision locators must be used in the peak mode to detect a null response.

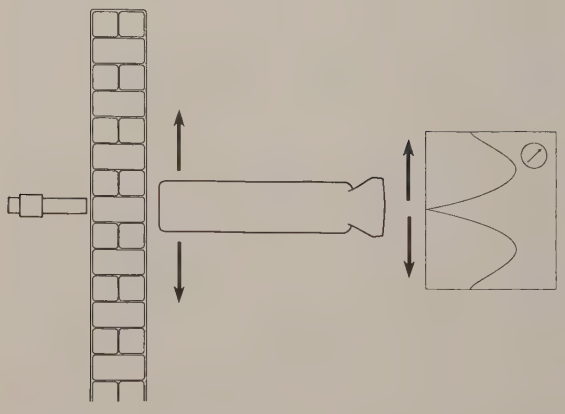
Align the receiver directly above the sonde and advance the receiver 1m/yard along the line of the main. Then hold the receiver stationary, directly above and with the blade in line with the main.

Push the sonde 1m/yard along the main. Continue advancing the receiver and the transmitter in alternate increments of 1m/yard. When the sonde passes a joint the receiver will be in range to detect it and will give a peak response: halt the sonde.

When a joint has been detected and the sonde halted, the joint position is accurately pinpointed by holding the receiver above and with the blade parallel to the line of the pipe. Move it backwards and forwards along the line of the pipe and it will give a sharp and precise null response directly above the pipe joint. It may be necessary to move the sonde gently backwards or forwards to get the null and the two peak responses.

It should be possible to push the Flexrod and sonde 120m/360ft along the pipe and possible to survey 240m/760ft for joints from a single insertion point.

Inserting a sonde in a gas pipe should only be undertaken by qualified gas industry personnel taking the necessary safety precautions.



5.9 Pinpointing a position on each side of a wall

The sonde gives a precise and easily defined null signal from its end.

The position where a sonde is placed endways against a wall can be pinpointed with great accuracy using the receiver on the far side of the wall.

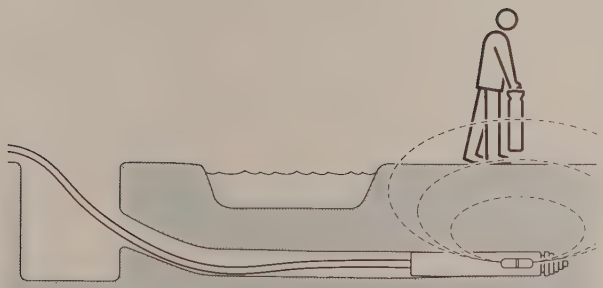
Procedure
Position sonde. With blade horizontal and pointing at the wall move the receiver horizontally to detect a null response between two peaks.

With receiver at null position pointing at wall, pivot receiver 90 degrees so that blade is vertical and move up and down to detect a null response.

Repeat the procedure for accurate position.

5.10 Locating blockages cable pulling

An obstruction in a non-metallic duct can be located from the surface if a sonde is inserted in the cable pull sock.



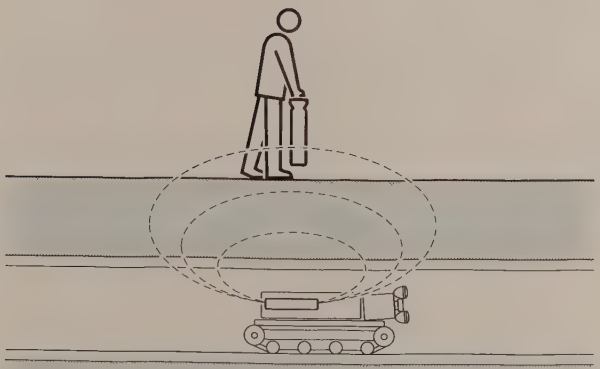
5.11 Monitoring a horizontal boring tool

Attaching or fitting a sonde to a horizontal boring tool enables the user with the receiver to monitor the progress of the boring tool and to check if it is on course or if it has deviated and needs to be retrieved. A record can be made of the plan and depth profile of a bore under the highway.

The sonde can be attached to the hose immediately behind the tool with duct tape or clips. Special hose couplings are available to accommodate the Small Sonde and the Slim Sonde.

Some boring tool manufacturers have modified the head of their tool to accommodate a special sonde enabling the point of the tool to be pinpointed from the surface.

The technique to monitor a sonde fitted to a boring tool is similar to locating and tracing a sonde in a drain: first locate when the sonde is visible in the launch pit to set the sensitivity level and then make locates and depth measurements at short intervals.



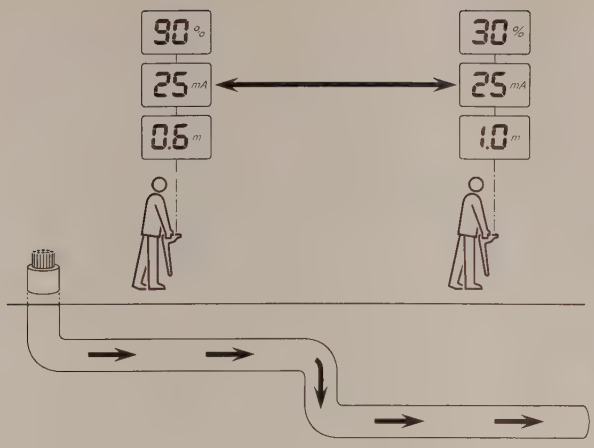
5.12 Locating inspection cameras

The purpose of an insepction camera is to provide information. Knowing the position of the camera from the surface enhances the value of the information: the ground can be marked directly over situations requiring remedial action or the position of the camera can be pinpointed in the event of it becoming stuck.

Some manufacturers of small camera systems incorporate the sonde inside the camera housing and feed if from the existing power supply.

A sonde element can be fitted inside a large camera or a Standard Sonde can be attached to the outside housing of the camera.

In each case, the routine of monitoring the progress of the camera and pinpointing its position is the same as locating and tracing a sonde in a drain.



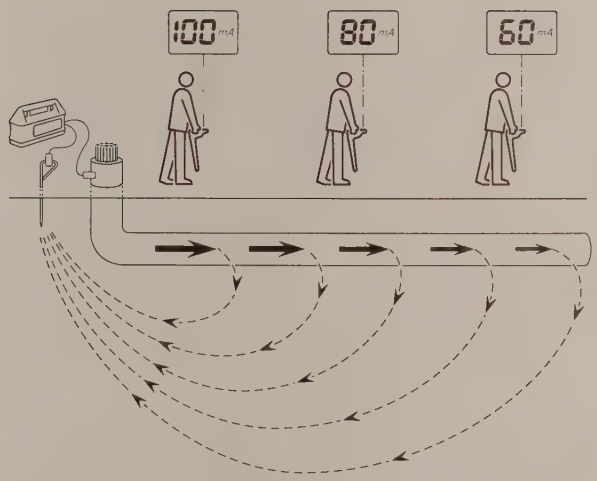
6 Measuring current on a target line

In addition to their locating and depth measuring capability, RD400 series locators fitted with a liquid crystal display can be used to measure the current on a line irrespective of its depth.

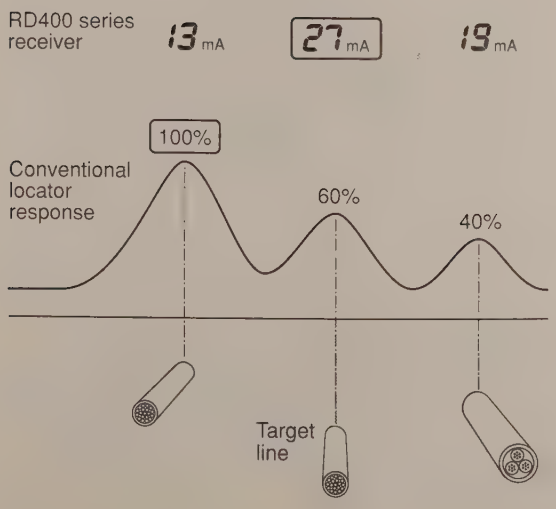
6.1 Current measurement: necessary information

Utility companies owning buried lines need to know not only the position and depth of their buried plant but also need confirmation of a line's identity and need as much information as possible about the condition of a line.

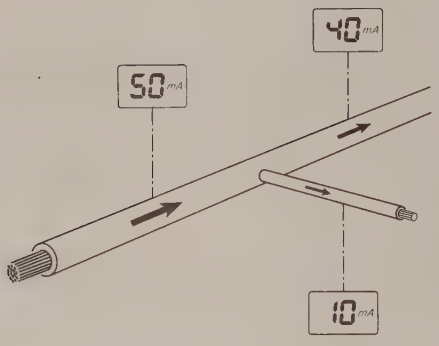
Current measurement of a target line provides additional information which is not available from a conventional locator.



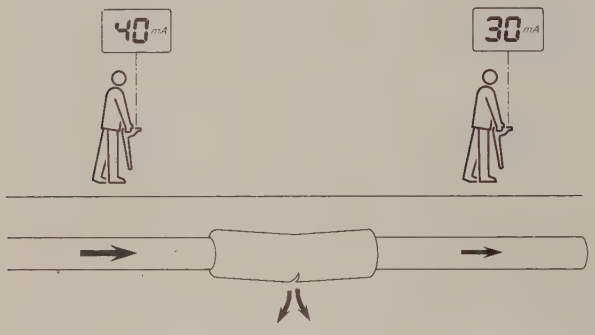
The locator transmitter applies a signal or current onto a target line and this current reduces in strength as the distance from the transmitter increases. This rate of reduction or attenuation depends on the type of line and on soil conditions. Regardless of the type of line, the rate of attenuation should be essentially regular with no sudden drops or changes. Any sudden or abrupt current drop indicates that the line or its condition has had a change.



6.1.1 Measuring current on a target line helps to confirm the identity of the line. In congested areas a locator often detects a stronger signal from an adjacent line because the signal has coupled to it and it is nearer the surface. It is not possible to positively identify a target line unless the current is measured and compared with other lines radiating the signal: the line with the highest current measurement is the target line to which the transmitter signal has been applied.



6.1.2 Measuring current provides useful information about the position of the tees. Measuring current after a tee will indicate the main line which pulls more current along its greater length and distinguishes it from the tee.



6.1.3 Measuring current before and after a cable joint or splice indicates its integrity or if there is a leak to ground or an open fault.

6.1.4 Locating faults in cable insulation or pipeline coating.

A sharp drop in response while tracing a line indicates the presence of some anomaly. Measure current a few paces before the response change and a few paces after the change. No loss of current indicates that the response has changed because of change in depth.

Check for a tee if there is a drop in current by sweeping with the locator in an arc four or five paces from the point of current drop.

If there is no tee and the depth of the line is constant, the fall in response indicates some anomaly on the line such as a coating or insulation failure allowing current to leak to ground. The user's experience will indicate if it is worth digging to investigate the reason for the current loss.

6.1.5 The current measurement capability of the locator can be used to monitor the state of the coating or insulation of a length of line. Readings taken along a line at regular intervals of time will indicate if the condition of the coating or insulation has degraded. See section 6.4.

6.2 Accuracy of current measurement

6.2.1 In ideal conditions current measurements should be accurate to within 5% on lines buried at depths down to 1m/3ft and 10% at greater depths.

Changes in current readings of less than these tolerances should not be regarded as relevant.

6.2.2 Greater errors will occur on sites with high interference, stray currents and coupling to nearby lines.

6.2.3 Adverse conditions that would normally affect accuracy of depth measurement will also affect accuracy of a current measurement, see section 3.4. Make a precision pinpoint before attempting current measurement, see section 3.3.3. Only make the measurement if the position of the responses from the peak and null modes correspond. Observe the precautions that are necessary for making an accurate depth measurement.

6.3 Procedure for measuring current

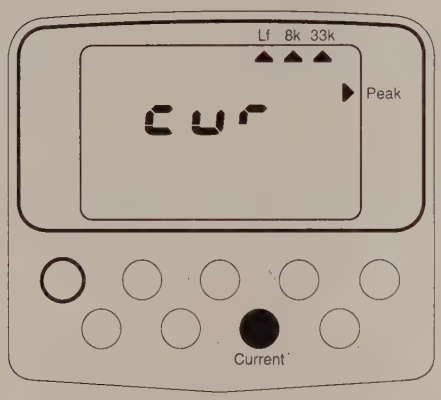
6.3.1 Applying the transmitter signal

The transmitter signal can be connected, clamped or induced to the target line in the same way as applying the signal for line tracing.

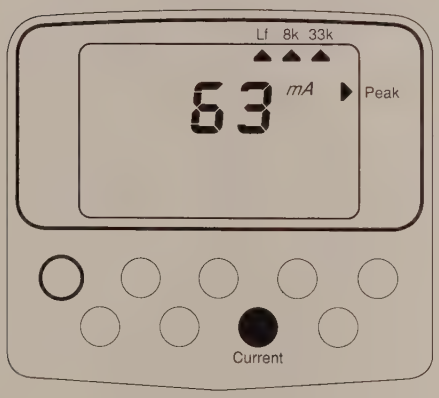
6.3.2 Measuring current

First pinpoint the line and confirm the accuracy of the peak pinpoint with a null pinpoint, see section 3.3.3.

Check the receiver is directly over the line, the blade at right angles to it and vertical (check bubble level). Adjust sensitivity level to bring the meter indication on scale. Check receiver is in line mode. Key in Current. The liquid crystal display will indicate 'cur' followed by the current value in mA which will be displayed for a few seconds. Keep depressed for a continuous reading.



Signal from the transmitter coupled to a nearby line may distort the accuracy of the measurement. If the reading is suspect sweep the area to check if other nearby lines are radiating a signal. If their signals cause interference it may be necessary to make the current measurement at another point along the line.



6.3.3 The clamp or stethoscope antennas cannot be used to measure current.

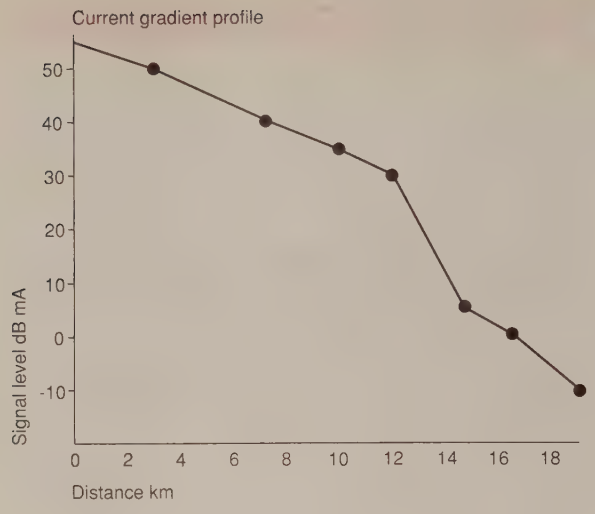
6.4 Monitoring a length of line

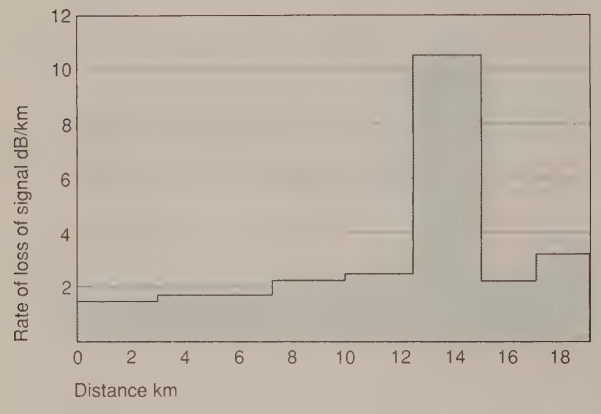
Decay of the insulation or coating on a length of line can be monitored by making current measurements at positions along the line every six or twelve months or other suitable period.

6.4.1 The measurements may be made at convenient points that do not need to be the same distance apart. Road crossings or points of access for a vehicle are suitable.

Make a current measurement at each access point along the length of the line.

Since current is expected to be attenuated logarithmically, the measured current values are first converted to decibels.





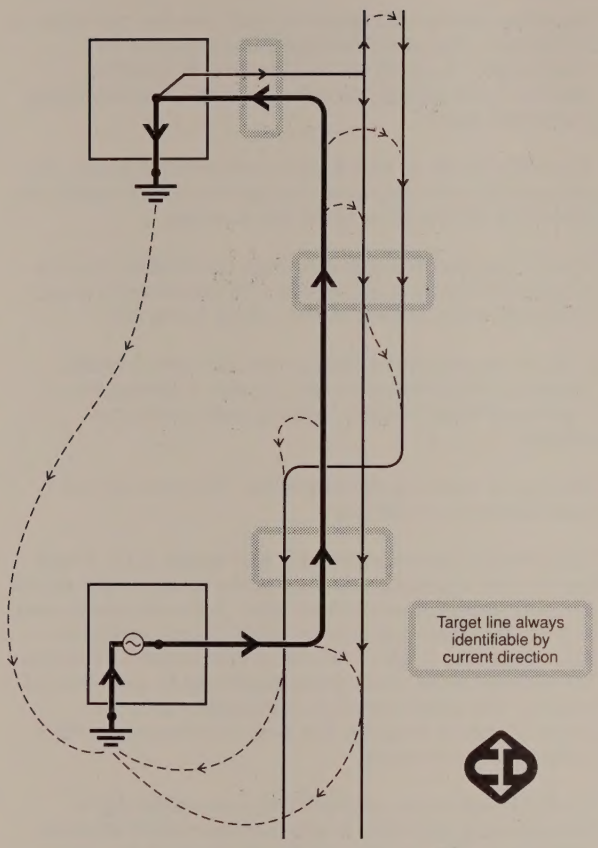
6.4.2 Convert the mA reading into dB. (dB = 20 $\log_{10}$ mA). Determine the amount of current loss by subtracting the dB current measurement at the end of the section from that at the beginning. Determine the rate of current loss by dividing the dB current loss by the length of the section to give a quantity of dB/km.

6.4.3 Example
The current measurement is used to make current readings at intervals along a 19km length of line. A graph showing the current gradient and a second graph highlighting sections with a high rate of current loss are derived from the readings.

Typical rate of loss is about 2dB/km and only one section exhibits loss in excess of 8dB. Result: a 19km length is rapidly evaluated and the problem area reduced to a single 2.5km section that requires further investigation.

	Measured values		Calculated values			
Reading no. n	**Distance km $d_{(n)}$**	**Section interval km $i_{(n)} = d_{(n)} - d_{(n-1)}$**	**Signal mA $I_{(n)}$**	**Signal dB mA $S_{(n)} = 20 \log_{10} I_{(n)}$**	**Signal loss dB $L_{(n)} = S_{(n)} - S_{(n-1)}$**	**Rate of loss dB/km $L_{(n)} / i_{(n)}$**
1	0	-	500	54	-	-
2	3.0	3.0	330	50.4	3.6	1.2
3	7.3	4.3	140	42.9	7.5	1.7
4	9.9	2.6	75	37.5	5.4	2.1
5	12.25	2.35	36	31.1	6.4	2.7
6	14.7	2.45	1.8	5.1	26.0	10.6
7	16.9	2.2	0.95	-0.4	5.5	2.5
8	19.0	2.1	0.45	-6.9	6.5	3.1

6.4.4 To monitor changes in the line's integrity, repeat the series of current measurements in exactly the same places and plot a new current gradient profile. Increases in the rate of current loss shown when comparing with the previous profile indicate sections of the line that may require investigation. This investigation can be done by walking the section and making current measurements at convenient intervals, perhaps every 200 paces. It should then be possible to determine the short length of line with the highest loss of current by making measurements every ten paces.



7 Current direction recognition

The importance of safeguarding critical pipes and cables is generally recognised. Location of these buried lines has ceased to be a problem other than in the most congested areas, but identity of the line has often been mistaken particularly if other lines run adjacent to the target line.

CD recognition (Current Direction Recognition) is a feature that helps resolve the problem of providing the user with a positive means of cable identification even at points distant from the application of the signal.

7.1 CD applications

7.1.1 The CD recognition feature on the receiver indicates the direction of the flow of current on a long line. Identity of the target line is established if the receiver indicates that the current is flowing forward and away from the point of application of the transmitter signal.

Signal that has coupled onto adjacent lines has found a return path back to the point of the original signal application and this is indicated by the receiver display arrow pointing backwards toward the transmitter.
The forward arrow indicates the target line. The backward arrow indicates other nearby lines to which the signal has coupled.

7.1.2 If the CD signal is required to travel over very long distances it may be necessary to prevent the signal applied by the transmitter being lost through known grounding points by fitting gas discharge tubes to supply low voltage isolation.

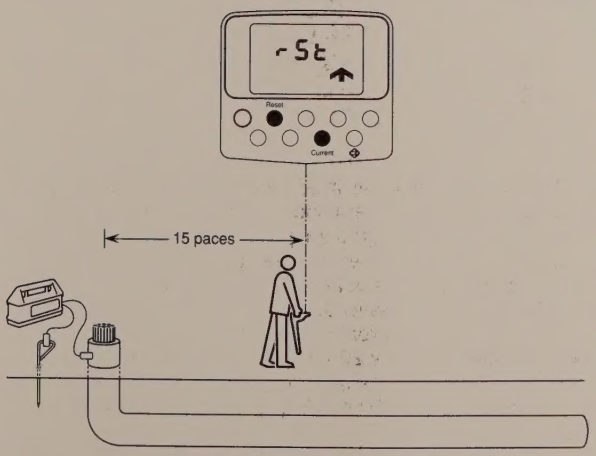
7.2 CD recognition procedure

7.2.1 The CD signal is applied with the RD433HCTx transmitter. The signal must be connected to the target line; the signal cannot be applied by clamp or induction.

7.2.2 The signal can also be applied from a Radiodetection RD431LMS (Line Management System) permanently installed at an access point to the line and connected to it.

7.2.3 It is necessary to set (or reset) the receiver with a CD reference before using the CD feature to define Current Direction. After applying the transmitter signal, trace the target cable for about 15 paces from the transmitter, away from the transmitter.

Press and hold down the Reset key. Momentarily press the key. Release the Reset key. The display will indicate 'rSt' followed by the forward-pointing CD arrow.



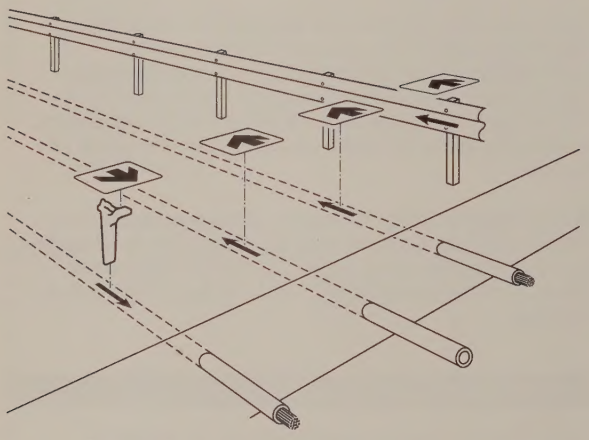
Reset the receiver CD reference each time the transmitter is turned off or the transmitter signal disconnected and reconnected. It should not be necessary to reset the receiver if it is used on the same line with an uninterrupted transmitter signal.

If the RD431LMS or RD433HCTx transmitter is distant, the set procedure can be carried out next to a joint or splice box where the identity of the target line is certain.

7.2.4 It may be difficult to determine the direction of a line for resetting the receiver (whether the transmitter is ahead or behind) when locating midway along a long line.

If this is the case find a nearby conductor with a visible identity to which the signal has coupled. A railway line, a continuous metal fence or highway crash barrier are suitable.

Make a CD locate on the visible line. The arrow will point back toward the transmitter.



7.2.5 Make a precision pinpoint, see section 3.3.3. Check the receiver is directly over the line, the blade at right angles to it and vertical (check bubble level). Adjust sensitivity level to bring the meter indication on scale. Check receiver is in Line mode. Key in ⌖. The liquid crystal display will indicate 'cd' followed by an arrow. Keep depressed for a continuous reading. The target line will be indicated by an arrow pointing forward along the line away from the transmitter's application of the signal.

7.2.6 If a nearby line also radiates a transmitter signal, pinpoint it and key in CD to establish the current direction. The arrow points back toward the transmitter if the signal has coupled to it from the target line.

7.2.7 The combination of finding the signal from a line with the strongest current (Section 6) and confirming that there is a forward direction current flow will establish the identity of a target line.